M7 Series

Diagnostic Ultrasound System

Service Manual

Revision 6.0

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Revision History

Mindray may revise this publication from time to time without written notice.

Revision	Date	Reason for Change
5.0	2012.3.30	1. Increase “4.2 Field Replaceable Unit” list with pictures and important information. 2. Change “6 Maintenance Requirement” to “6 Function and Performance Checking Method”, increase detailed information of checking. 3. Change “7 Checking” to “6 Care and Maintenance”, increase detailed information of maintaining. 4. Change “8 System Maintenance” to “7 System Self-diagnosis”, move the content of cleaning to the chapter 8. 5. Increase “Electrical Safety Inspection” normative description and delete original content of electrical safety. 6. Increase CW installation method in 4.3.5. 7. Modify several clerical errors in the initial release.
6.0	2013.4.17	1. Add FRU part number for HDD of different regions/types (CE/FDA/human/vet) in 4.2 2. Add warning that human resume package is not compatible with vet machine, and vet resume package is not compatible with human machine.
7.0	2013.6.24	Add “The attentions to the assembly/disassembly, otherwise the hard disk will be damaged” to Chapter 4.3.14.

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Mindray is responsible for the effects on safety, reliability and performance of this product, only if:

- all installation operations, expansions, changes, modifications and repairs of this product are conducted by Mindray authorized personnel;
- the electrical installation of the relevant room complies with the applicable national and local requirements; and
- the product is used in accordance with the instructions for use.
- MindrayVNC ver. 1.0 is free open source software, the performance of MindrayVNC ver. 1.0 is not guaranteed by MINDRAY.

⚠ Note ⚠

This equipment must be operated by skilled/trained clinical professionals.

⚠ Warning ⚠

It is important for the hospital or organization that employs this equipment to carry out a reasonable service/maintenance plan. Neglect of this may result in machine breakdown or personal injury.

Warranty

THIS WARRANTY IS EXCLUSIVE AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

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Mindray's obligation or liability under this warranty does not include any transportation or other charges or liability for direct, indirect or consequential damages or delay resulting from the improper use or application of the product or the use of parts or accessories not approved by Mindray or repairs by people other than Mindray authorized personnel.

This warranty shall not extend to:

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- **Malfunction or damage caused by unstable or out-of-range power input.**
- **Malfunction or damage caused by force majeure such as fire and earthquake.**
- **Malfunction or damage caused by improper operation or repair by unqualified or unauthorized service people.**
- **Malfunction of the instrument or part whose serial number is not legible enough.**
- **Others not caused by instrument or part itself.**

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Important Information

1. It is the customer's responsibility to maintain and manage the system after delivery.
2. The warranty does not cover the following items, even during the warranty period:
   (1) Damage or loss due to misuse or abuse.
   (2) Damage or loss caused by Acts of God such as fires, earthquakes, floods, lightning, etc.
   (3) Damage or loss caused by failure to meet the specified conditions for this system, such as inadequate power supply, improper installation or environmental conditions.
   (4) Damage or loss due to use of the system outside the region where the system was originally sold.
   (5) Damage or loss involving the system purchased from a source other than Mindray or its authorized agents.
3. This system shall not be used by persons other than fully qualified and certified medical personnel.
4. DO NOT make changes or modifications to the software or hardware of this system.
5. In no event shall Mindray be liable for problems, damage, or loss caused by relocation, modification, or repair performed by personnel other than those designated by Mindray.
6. The purpose of this system is to provide physicians with data for clinical diagnosis. It is the physician's responsibility for diagnostic procedures. Mindray shall not be liable for the results of diagnostic procedures.
7. Important data must be backed up on external memory media.
8. Mindray shall not be liable for loss of data stored in the memory of this system caused by operator error or accidents.
9. This manual contains warnings regarding foreseeable potential dangers, but you shall always be alert to dangers other than those indicated as well. Mindray shall not be liable for damage or loss that results from negligence or from ignoring the precautions and operating instructions described in this operator's manual.
10. If the manager for this system is changed, be sure to hand over this operator's manual to the new manager.

Safety Precautions

1. Meaning of Signal Words

In this manual, the signal words **“⚠DANGER”, “⚠WARNING”, “⚠CAUTION”, “NOTE”** are used regarding safety and other important instructions. The signal words and their meanings are defined as follows. Please understand their meanings clearly before reading this manual.

Signal Word	Meaning
⚠DANGER	**Indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury.**
⚠WARNING	**Indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.**
⚠CAUTION	**Indicates a potentially hazardous situation that, if not avoided, may result in minor or moderate injury.**
NOTE	Indicates a potentially hazardous situation that, if not avoided, may result in property damage.

2. Meaning of Safety Symbols

Symbol	Description
	Type-BF applied part. The ultrasound probes connected to this system are type-BF applied parts. The ECG leads applied on this system are type-BF applied parts, too.
	“Attention” indicates the points that you should pay attention to. Be sure to read the operator’s manual concerning these points before using the system.

3. Safety Precautions

Please observe the following precautions to ensure patient's and operator's safety when using this system.

⚠DANGER:	**Do not use flammable gasses, such as anesthetic gas, oxygen or hydrogen, or flammable liquids such as ethanol, near this system, because there is danger of explosion.**

⚠WARNING:

1. **Do connect the power plug of this system and power plugs of the peripherals to wall receptacles that meet the ratings indicated on the rating nameplate. Using an adapter or multifunctional receptacle may affect the system's grounding performance, and cause the leakage current to exceed safety requirements. You must use the power cord provided with the system.**
2. **Use the cable provided with this system to connect the printer. Other cables may result in electric shock.**
3. **Before cleaning the system, disconnect the power cord from the outlet. System failure and electric shock may result.**
4. **DO NOT use a probe that has a damaged, scratched surface, or exposed wiring of any kind. Immediately stop using the transducer and contact Mindray Customer Service Department or sales representative. There is risk of electric shock if using a damaged or scratched transducer.**
5. **This system is not water-proof. Do not use this system in any place where water leakage may occur. If any water is sprayed on or into the system, electric shock may result. If water is accidentally sprayed on or into the system, contact Mindray Customer Service Department or sales representative.**
6. **Do not allow the patient to contact the live parts of the ultrasound system or other devices, e.g. signal I / O ports. Electric shock may occur.**
7. **Do not use an aftermarket transducer other than those specified by Mindray. The transducers may damage the system causing a profound failure, e.g. a fire in the worst case.**

8. **Do not subject the transducers to knocks or drops. Use of a defective transducer may cause an electric shock.**
9. **Do not open the covers and front panel of the system. Otherwise, short circuit or electric shock may result.**
10. **Do not use this system when any digital device such as a high-frequency electrotome, high-frequency therapeutic device or defibrillator is applied already. Otherwise, there is a risk of electric shock to the patient.**
11. **When moving the system, you should first fold the LCD display, disconnect the system from other devices (including transducers) and disconnect the system from the power supply. Separate the system from the mobile trolley before transportation.**
12. **Prolonged and repeated use of keyboards may result in hand or arm nerve disorders for some individuals. Observe the local safety or health regulations concerning the use of keyboards.**
13. **Accessory equipments connected to the analog and digital ports must comply with the relevant IEC standards (e.g., IEC 60950 information technology equipment safety standard and IEC 60601-1 medical equipment standard).Furthermore, all configurations must comply with the standard IEC 60601-1-1.It is the responsibility of the person, who connects additional equipment to the signal input or output ports and configures a medical system, to verify that the system complies with the requirements of IEC 60601-1-1.If you have any questions regarding these requirements, consult your sales representative.**

⚠CAUTION:

1. **Precautions concerning clinical examination techniques:**

This system must be used only by qualified medical professionals.

This operator's manual does not describe clinical examination techniques. The clinician should select the proper examination techniques based on specialized training and clinical experience.

2. **Malfunctions due to radio wave:**

   If a radio wave emitting device is used in the proximity of this system, it may interfere with operations. Do not bring or use devices that generate radio waves, such as cellular telephones, transceivers, and radio controlled toys, in the room where the system is installed.

   If a person brings a device that generates radio waves near the system, ask him / her to immediately turn OFF the device.

3. **Precautions concerning movement of the system:**

   When you place the system on the mobile trolley and move them together, you must secure all objects on the mobile trolley to prevent them from falling. Otherwise you should separate the system from the mobile trolley and move them individually.

   When you have to move the system with the mobile trolley upward or downward the stairs, you must separate them first and then move them individually.

   Object placed on the monitor may fall and injure an individual when moving.

   Fasten and fully secure any peripheral device before moving the system. A loose peripheral device may fall and injure an individual.

4. **If the circuit protector is tripped, it indicates that the system or a peripheral device was improperly shut down and the system is unstable. You cannot repair the system under this circumstance and must call the Mindray Customer Service Department or sales representative.**

5. **There is no risk of high-temperature burns during normal ultrasound examinations. It is possible for the surface temperature of the transducer to exceed the body temperature of a patient due to environmental temperature and exam type combinations. Do not apply the transducer to the same region on the patient for a long time. Apply the transducer only for a period of time required for the purpose of diagnosis.**

6. **Do not use the system to examine a fetus for a long period of time.**

7. **The system and its accessories are not disinfected or sterilized prior to delivery. The operator is responsible for the cleaning and disinfection of transducers and sterilization of biopsy brackets according to the manuals, prior to the use. All items must be thoroughly processed to completely remove harmful residual chemicals, which will not only harmful to the human body, but also damage the accessory.**
8. **It is necessary to press <End Exam> to end the current scan that is in progress and clear the current Patient Information field. Otherwise, new patient data may be combined with the previous patient data.**
9. **Do not connect or disconnect the system's power cord or its accessories (e.g., a printer or a recorder) without turning OFF the power first. This may damage the system and its accessories or cause electric shock.**
10. **Read the Acoustic Output Principle in the operation manual carefully before operate this system on clinical examination.**
11. **The cover contains natural rubber that can cause allergic reactions in some individuals.**
12. **Please use the ultrasound gel compliant with the relevant local regulations.**
13. **Do not connect this system to outlets with the same circuit breakers and fuses that control the current of devices such as life-support systems. If malfunctions or over-current appear on this system, or when there is an instantaneous current at power ON, the breakers and fuses of the building's supply circuit may be tripped.**

NOTE:
1. Do not use the system in the vicinity of strong electromagnetic field (such as a transformer), which may affect the performance of the system.
2. Do not use the system in the vicinity of high-frequency radiation source, which may affect the performance of the system or even lead to failure.

3. To avoid damaging the system, DO NOT use it in following environment:
   - Locations exposed to direct sunlight;
   - Locations subject to sudden changes in environmental temperature;
   - Dusty locations;
   - Locations subject to vibration;
   - Locations near heat generators;
   - Locations with high humidity.
4. Turn ON the system only after the power has been turned OFF for more than 20 seconds. If the system is turned ON immediately after being turned OFF, the system may not be rebooted properly and could malfunction.
5. Press <Freeze> or turn off the power of the system before connecting or disconnecting a transducer. Otherwise, the system and / or transducer may be damaged.
6. Remove ultrasound gel from the face of a probe when the examination is complete. Water in the gel may enter the acoustic lens and adversely affect the performance and safety of the transducer.
7. You should properly back up the system to a secure external storage media, including system configuration and settings and patient data. Data stored to the system's hard drive may be lost due to system failure, improper operation or accident.
8. Do not apply external force to the control panel. Otherwise, the system may be damaged.
9. If the system is used in a small room, the room temperature may rise. Please provide proper ventilation and free air exchange.
10. When using or placing the system, keep the system horizontal to avoid disbalance.
11. To dispose of the system or any part, contact Mindray Customer Service Department or sales representative. Mindray is not responsible for any system content or accessories that have been discarded improperly. Mindray is not responsible for any system content or accessories that have been discarded improperly.
12. Electrical and mechanical performance may be degraded due to long usage (such as current leakage or distortion and abrasion), the image sensitivity and precision may become worse too. To ensure optimal system operations, it is recommended that you maintain the system under a Mindray service agreement.

13. Do not use gel, disinfectant, transducers or needle-guided brackets that are not compatible with the system.
14. The replaceable fuse is inside the chassis. Refer replacing job to Mindray service engineers or engineers authorized by Mindray only.
15. Do not turn OFF the power supply of the system during printing, file storage or invoking other system operations. An interrupted process may not be completed, and can become lost or corrupted.
16. If the system is powered off improperly during operation, it may result in data damage of the system's hard disk or system failure.
17. Do not use a USB memory device (e.g., an USB flash drive, removable hard disk) which has unsafe data. Otherwise, system damage may result.
18. It is recommended to only use the video devices specified in this manual.
19. When using this system with portable package, be careful not to block the ventilation slots.
20. DO NOT directly remove a USB memory device during file being copied; otherwise, the USB memory device and/or the system may be damaged.
21. Do not connect a removable hard disk of many partitions to the system.
22. Do not press any key on the control panel when perform DICOM file sending or file duplication from the USB memory devices.

4. Warning Labels

The warning labels are attached to this system in order to call your attention to potential hazards.

The symbol ⚠ on the warning labels indicates safety precautions. The warning labels use the same signal words as those used in the operator's manual.

Refer to the operator's manual for detailed information about the warning labels. Read operator's manual carefully before using the system.

5. Symbol Explanation

Symbol	Name	Function
	Power off	Power button
	Power on	
	Remote control port	I/O panel
	Video print control	
	Video out	
	VGA out	
	Footswitch port	
	USB	
	ETHERNET	
A	Transducer port A	Transducer port
B	Transducer port B	

1 System Overview

1.1 Intended Use

This product is applicable in ultrasound examining room, ward, emergency, anesthesia room and operating room, etc.

M7, M7T, M7 Expert, M7 Super

Applicable for examinations to adults, pregnant women, pediatric patients and neonates, and it is intended for use in abdominal, cardiac, small parts (breast, testes, thyroid, etc.), peripheral vascular, fetal, transesophagel, transrectal, transvaginal, pediatric, neonatal cephalic, musculoskeletal (general and superficial), intraoperative, interventional, anesthesia (nerve), emergency, ICU/CCU, urology, sports health and transcranial exams.

M7Vet

M7Vet is a veterinary use color Doppler diagnostic ultrasound system, which is intended for use in clinical ultrasonic exams, such as abdominal, cardiac, small parts, peripheral vascular, transrectal, musculoskeletal (general and superficial), and intraoperative exams.

1.2 Contraindication

None.

1.3 Product and Model Code

M – □

Model code

Product code

2 System Structure

2.1 Introduction of Each Unit

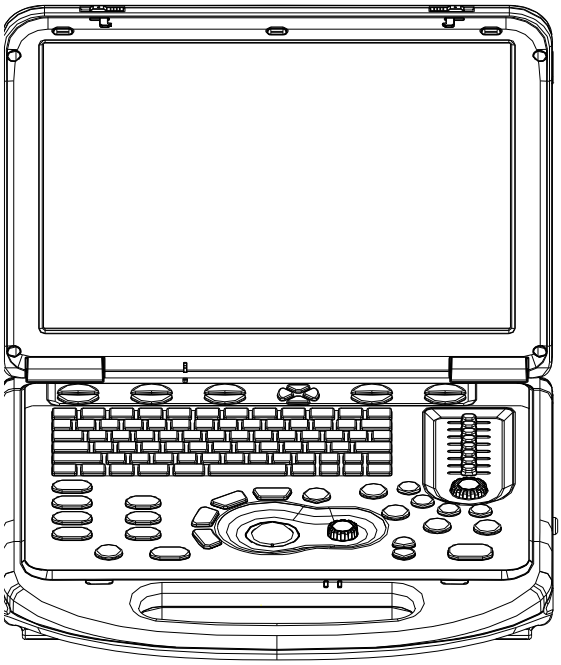


Fig 2-1 External Appearance of the System (1)

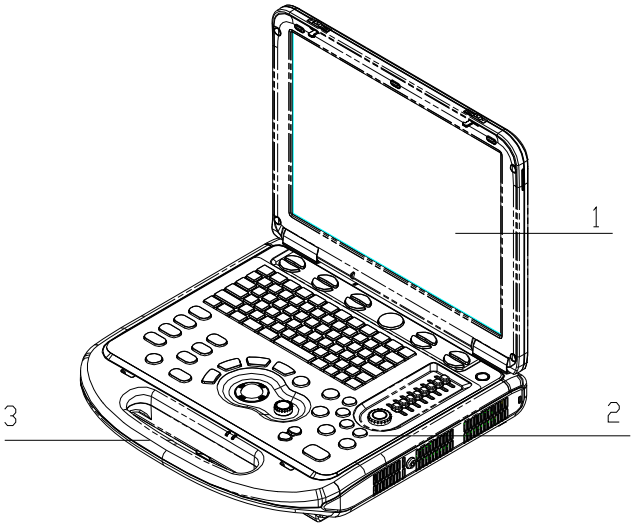


Fig 2-2 External Appearance of the System (2)

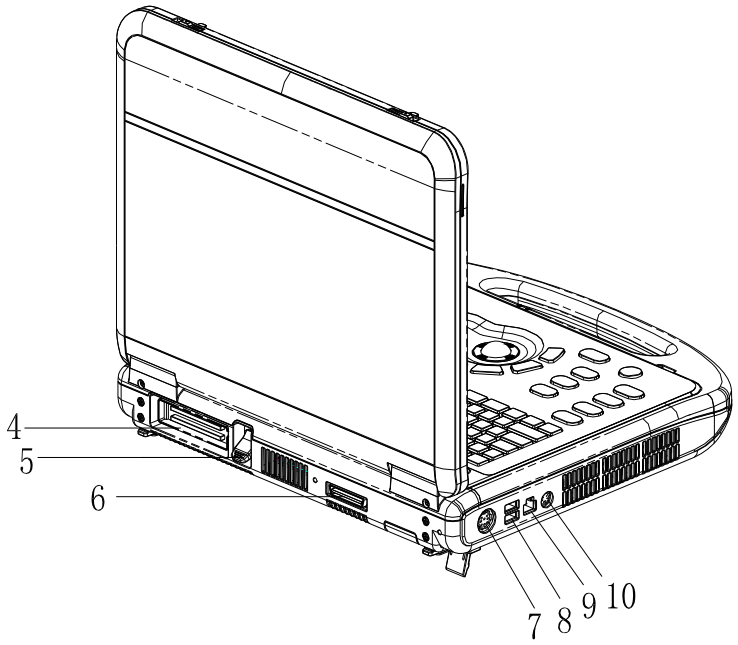


Fig 2-3 External Appearance of the System (3)

No.	Name	Function
1	Display	Displays the images and parameters during scanning.
2	Control panel	Operator-system interface or control
3	Handle	Used for carrying the system
4	Transducer port	Connects a probe to the main unit; or connects a probe extend module
5	Transducer locking lever	Locks or unlocks the probe connected with the main unit : Locked symbol : Unlocked symbol
6	IO extend port	Connects the IO extend module
7	Power input port 12V ⎓ 9A (Max.)	Connects the power adapter
8	USB port	Connects USB devices

No.	Name	Function
9	Network port	Connects the network
10	S-Video separate video output	Connects with image signal output devices like the video recorder, video printer, text/graph workstation and so on.

2.2 Peripherals Supported

- B/W video printer: MITSUBISHI: P93DC, SONY:UP-D897
- Color video printer: SONY: UP-D23MD
- DVD Recorder: MVR-11
- Graph/text printer

2.3 Extend Modules

Note:	Make sure VGA cable is not too long .

There are four extend modules available for the system: probe extend module, IO extend module, V/A extend module, and ECG module. Interfaces of each extend module is described as follows:

2.3.1 Transducer Extend Module

The system can be configured with 2 models of probe extend modules: PEM-11 and PEM-21.

- PEM-11
  - Introduction of each part

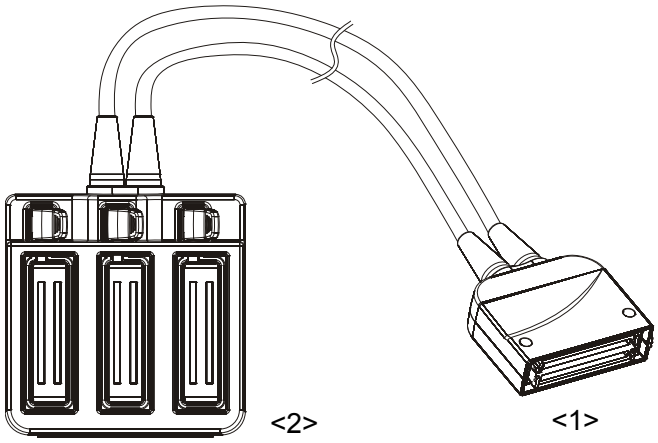


Fig 2-4 PEM-11 Transducer Extend Module

No.	Name	Function
<1>	Connector	Connects to the transducer port of the main unit, three extend ports are available.
<2>	Probe port	Extended ports for connecting two live transducers; the middle one is a parking port

- Connection

Turn off the ultrasound system, insert the module connector into the probe port with its bulge facing to the right side of the system (when you are facing to the front of the system).

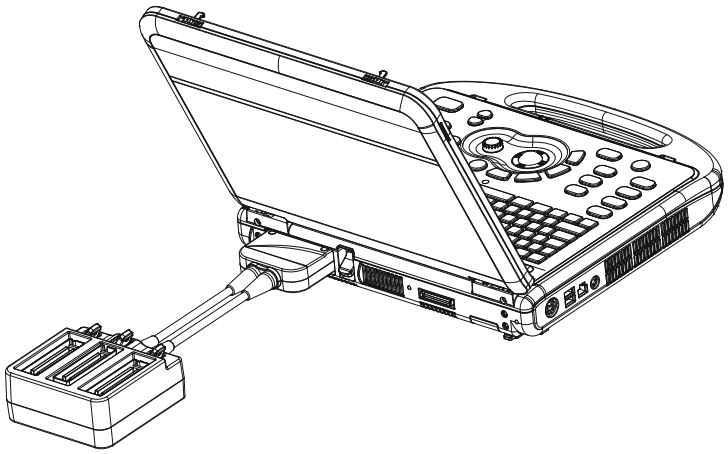


Fig 2-5 PEM-11 Connect the Transducer Extend Module

- PEM-21

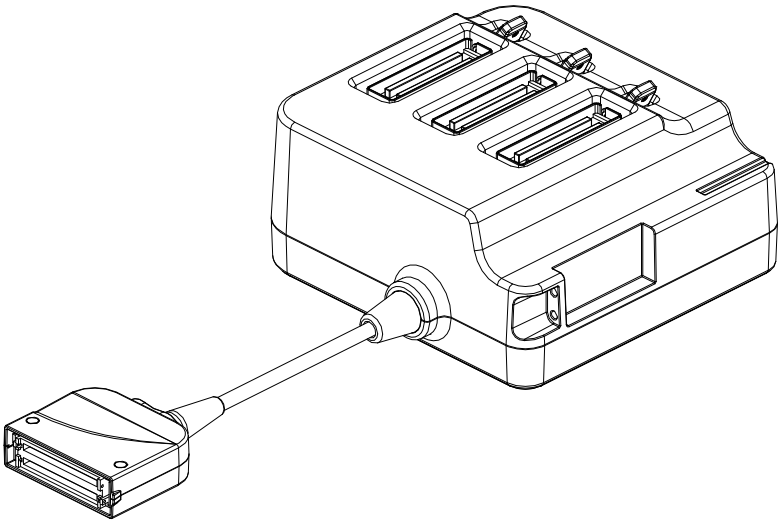


Fig 2-6 PEM-21 Transducer Extend Module

PEM-21 transducer extend module can be used only if the mobile trolley is configured, for the figures, please refer to the service manual of UMT-300.

⚠CAUTION: **You must turn off the ultrasound system before connecting or disconnecting the probe extend module. Otherwise the system may be damaged.**

NOTE: If you use the probe extend module to connect a probe, the image quality may be degraded.

2.3.2 I/O Extend Module.

- Interfaces

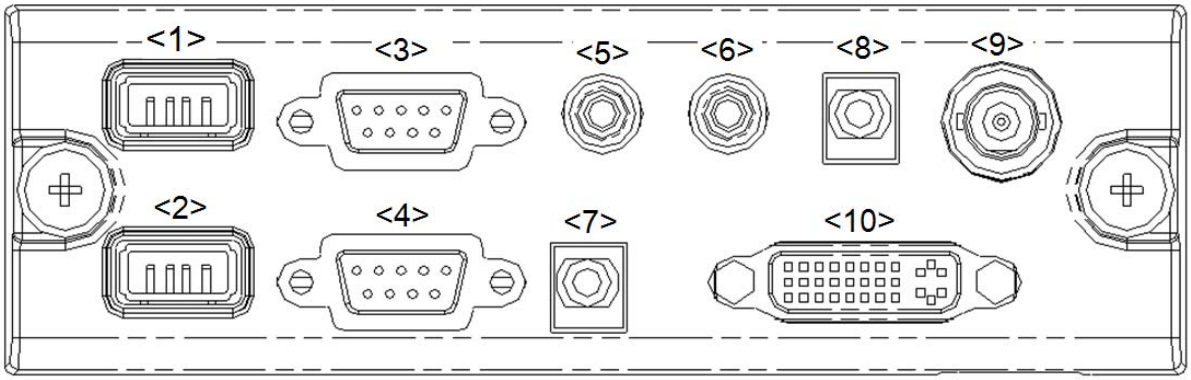


Fig 2-7 I/O Extend Module

No.	Symbol	Function
<1>、<2>	USB port	Connects USB devices.
<3>	ECG Port ECG	Connects the ECG Module
<4>	Serial port	Connects serial port devices
<5>、<6>	Audio output port	Used for audio signals of D mode sound from DVD output or audio comments
<7>	Mic In port	Reserved. (Connects a microphone used for receiving audio comments when a recorder is used to record images)
<8>	Remote control port	Connects the control port of the video printer

No.	Symbol	Function
<9>	Composite video output port	Connects with image signal output devices like the video recorder, video printer, text/graph workstation and so on.
<10>	DVI-I output port DVI-I	Connects a display or projector, etc.

■ Connection

Connect the I/O extend module to the main unit via the I/O extend port, thus the data port is extended. As shown in the following figure.

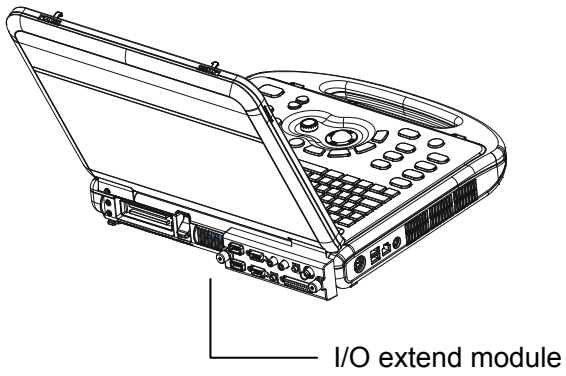


Fig 2-8 PEM-11 Connect the I/O Extend Module

2.3.3 V/A Extend Module

■ About the Interfaces

The module is connected to the USB port of the main unit via a USB cable.

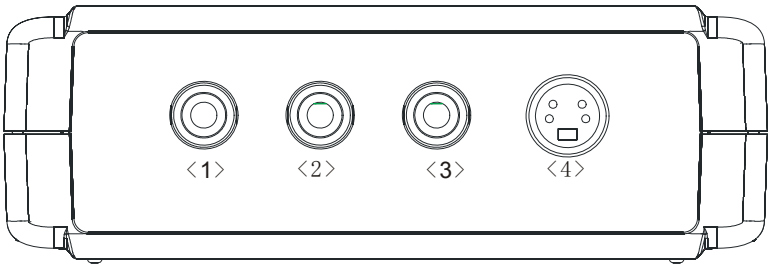


Fig 2-9 V/A Extend Module

No.	Name	Function
<1>	Audio input port	Used for audio signal input
<2>	Audio input port	Used for audio signal input

No.	Name	Function
<3>	Composite video input port	Used for composite signal video input
<4>	Separate video input port	Used for separate signal video input

- Connection

Connect the V/A extend module to the main unit via an USB port, after that, you can see USB 2861 Device and USB Audio Device in the device manager. V/A extend module connection is shown in the following figure.

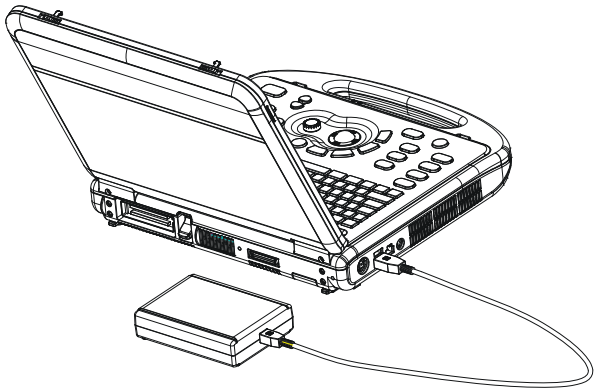


Fig 2-10 PEM-11 Connect the V/A Extend Module

2.3.4 ECG Module

- Interfaces

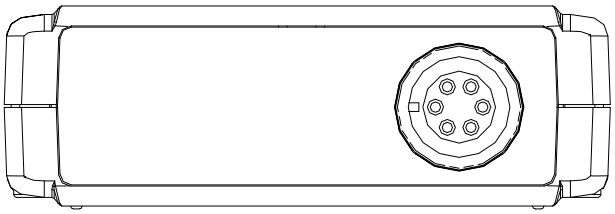


Fig 2-11 ECG Module

Name	Function
ECG lead port	Used for ECG signal input

- ECG Lead

Two kinds of ECG leads are available for M7: AHA standard and IEC standard. For FDA region, only the ECG leads of AHA standard can be selected, and for other regions, both kinds can be used.

- Connection

To use the ECG module, you need to configure with the I/O extend module at the same time.

First connect the I/O extend module, and then connect the ECG module to the I/O extend module, see the figure below:

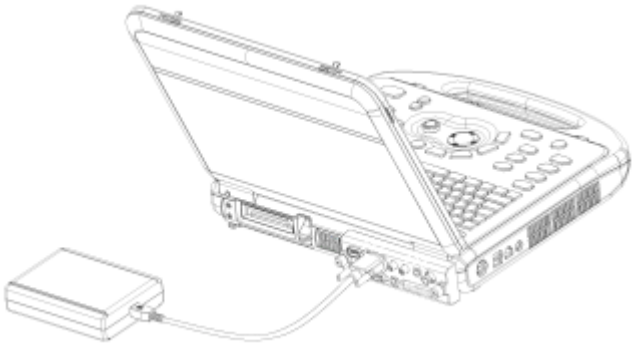


Fig 2-12 Connect the ECG Module

2.4 Control Panel

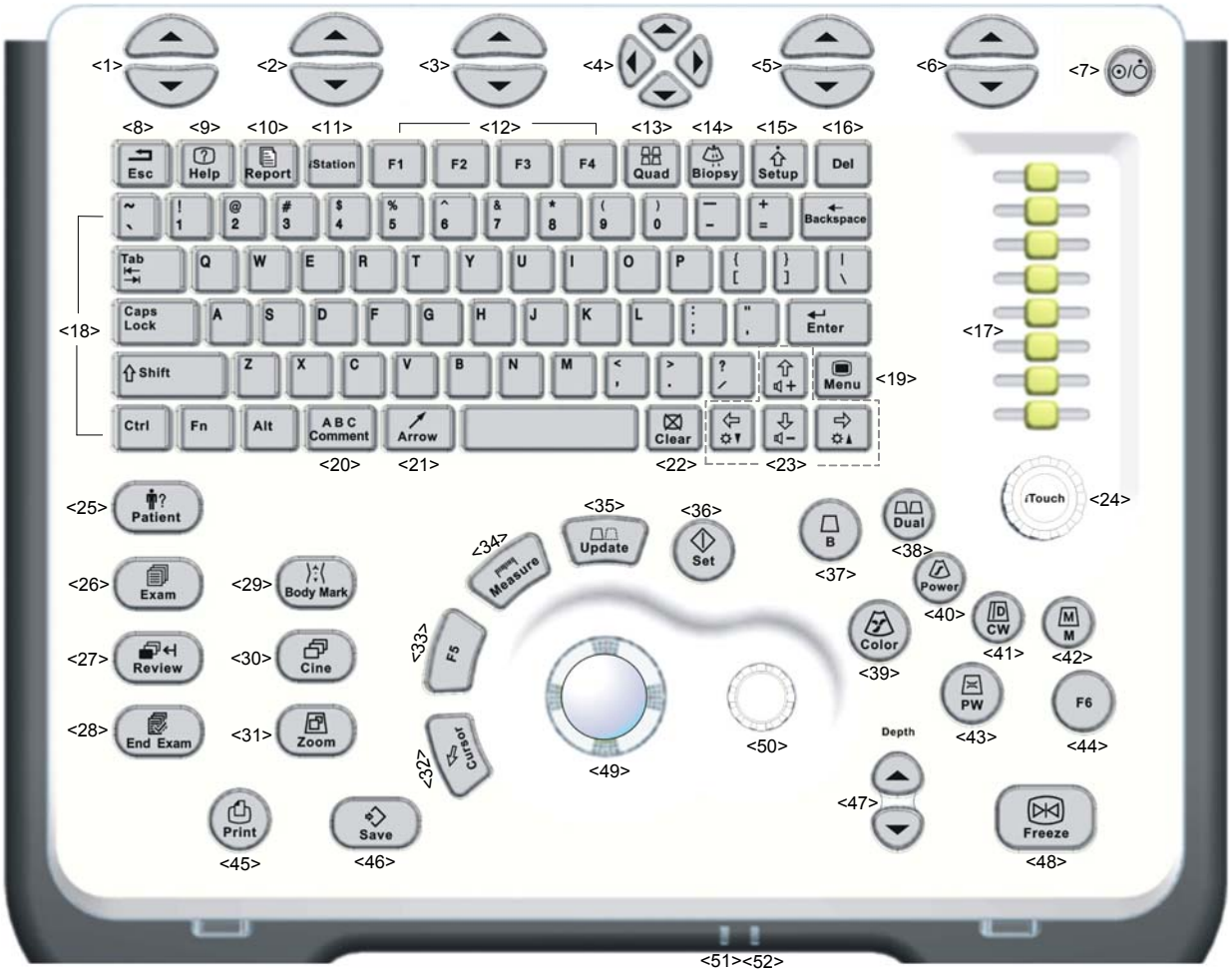


Fig 2-13 Control Panel

No.	Silk Print	Name	Function
<1>	/	Multifunctional key 1	Press to select the soft menu items displayed on the bottom of the screen. Refer to the subsequent contents for specific functions.
<2>	/	Multifunctional key 2	Press to select the soft menu items displayed on the bottom of the screen. Refer to the subsequent contents for specific functions.
<3>	/	Multifunctional key 3	Press to select the soft menu items displayed on the bottom of the screen. Refer to the subsequent contents for specific functions.
<4>	/	Multifunctional key 4	Up / down controls are used to turn pages up / down when there are more-than-one pages for the soft menu; Left / right keys are used to switch between the different modes.
<5>	/	Multifunctional key 5	Press to select the soft menu items displayed on the bottom of the screen. Refer to the subsequent contents for specific functions.
<6>	/	Multifunctional key 6	Press to select the soft menu items displayed on the bottom of the screen. Refer to the subsequent contents for specific functions.
<7>	/	Power button	Power button It does not illuminate when the system is turned off; Press the button to turn on the system, the system enters the work status and the indicator lights on in green. When the system enters the standby status, the indicator turns green.
<8>	Esc	Exit	Press to exit the current status to the previous status.
<9>	Help	Help	Press to open or close the accompanying help documents.
<10>	Report	Report	Press to open or close the diagnosis reports.

No.	Silk Print	Name	Function
<11>	iStation	/	Press to enter or exit the patient information management system.
<12>	F1-F4	User-defined key	You can assign a function to the key.
<13>	Quad	Quad-split screen	Press to enter or exit the quad-split screen display.
<14>	Biopsy	Biopsy	Press to show or hide the biopsy guide line.
<15>	Setup	Setup	Press to show or hide the Setup menu.
<16>	Del	/	Press to delete the comment, etc.
<17>	TGC	/	Move to adjust time gain compensation.
<18>	/	Alphanumeric keys	Same as those of PC.
<19>	Menu	Main menu	Press to display or hide a mode-specific parameter menu.
<20>	Comment	ABC (Comments)	Press to enter or exit the character comment status.
<21>	Arrow	Arrow	Press to enter or exit the arrow comment status.
<22>	Clear	Delete	Press to clear the comments or measurement calipers on the screen.
<23>	Up/down, left/right keys		Fn+/: to adjust volume or monitor brightness
<24>	iTouch	/	Rotate to increase or decrease the image gain; press to optimize the image, serving as a one-key optimization.
<25>	Patient	Patient Info	To enter into patient information input interface.
<26>	Exam	Exam Mode	Switch the exam mod and probe
<27>	Review	Review	To review the stored images.
<28>	End Exam	End Exam	Press to end an exam.
<29>	Body Mark	Body Marks (Pictograms)	Press to enter or exit the Body Mark status.

No.	Silk Print	Name	Function
<30>	Cine	Cine Review	Press to enter or exit the Cine Review status.
<31>	Zoom	Zoom	Press to enter or exit the Zoom status.
<32>	Cursor	Cursor	Press to show the cursor.
<33>	F5	User-defined key	You can assign a function to the key.
<34>	Measure	Measurement	Press to enter or exit the application measurement mode.
<35>	Update	/	Switching key: Press to change the currently active window. Press to start or end image capture in 3D/4D or iScape mode.
<36>	Set	Set	Press to confirm an operation, same as the left-button of the mouse.
<37>	B	/	Press to enter the B mode
<38>	Dual	/	Press to enter the Dual mode from another mode; Press to switch between the two display windows in the Dual mode.
<39>	Color	/	Press to enter the Color mode.
<40>	Power	/	Press to enter Power mode.
<41>	CW	/	Press to enter the CW mode.
<42>	M	/	Press to enter the M mode.
<43>	PW	/	Press to enter the PW mode.
<44>	F6	User-defined key	You can assign a function to the key.
<45>	Print	Print	Press to print: user-defined key.
<46>	Save	Storage	Press to save; user-defined key.
<47>	Depth	Depth	Press to increase or decrease the imaging depth in scanning mode.
<48>	Freeze	Freeze	Press to freeze or unfreeze the image.
<49>	/	Trackball	Roll the trackball to change the cursor position.

No.	Silk Print	Name	Function
<50>	/	Multifunction knob	Rotate to adjust the menu items, parameters and direction of the comment arrow, etc. Press to show the menu, and rotate the view the items.
<51>	/	Indicator 1	Indicates if the main unit is connected to the power supply. If not connected, the indicator does not illuminate; If connected, the indicator illuminates in green color.
<52>	/	Indicator 2	Indicates the current status of the batteries. When the system is supplied with power by the batteries and the power capacity is lower than 30%, the indicator is yellow and flashes. When the batteries are being charged, the indicator light is on and in yellow color. When the battery capacity is charged to the full capacity, the indicator color turns green. In other statuses, the indicator light is off.

Tip: "/" means the key / knob has no silk-printed name.

Keys which can work with the Fn key:

Key	Function
Fn+	Increase the brightness of the LCD display.
Fn+	Decrease the brightness of the LCD display.
Fn+S	Press the two keys to mute the speaker.
Fn+	Press the two keys to increase display contrast.
Fn+	Press the two keys to decrease display contrast.

3 Principle Description

3.1 Electric Principle of the System

The schematic diagram of M7 diagnostic ultrasound system is show in the following figure:

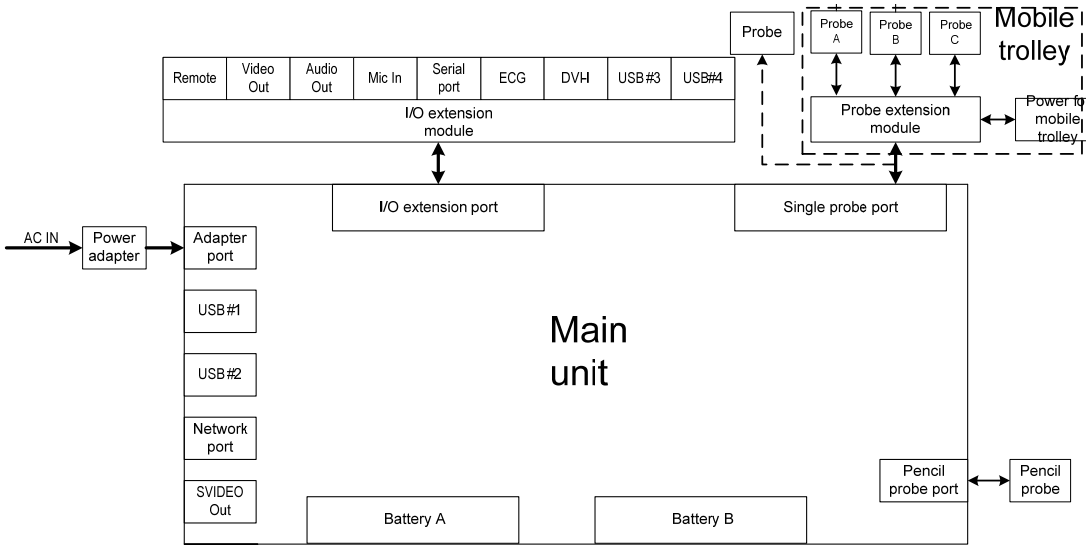


Fig 3-1 Schematic Diagram of System

According to functions of hardware, the block diagram of the hardware system is shown below:

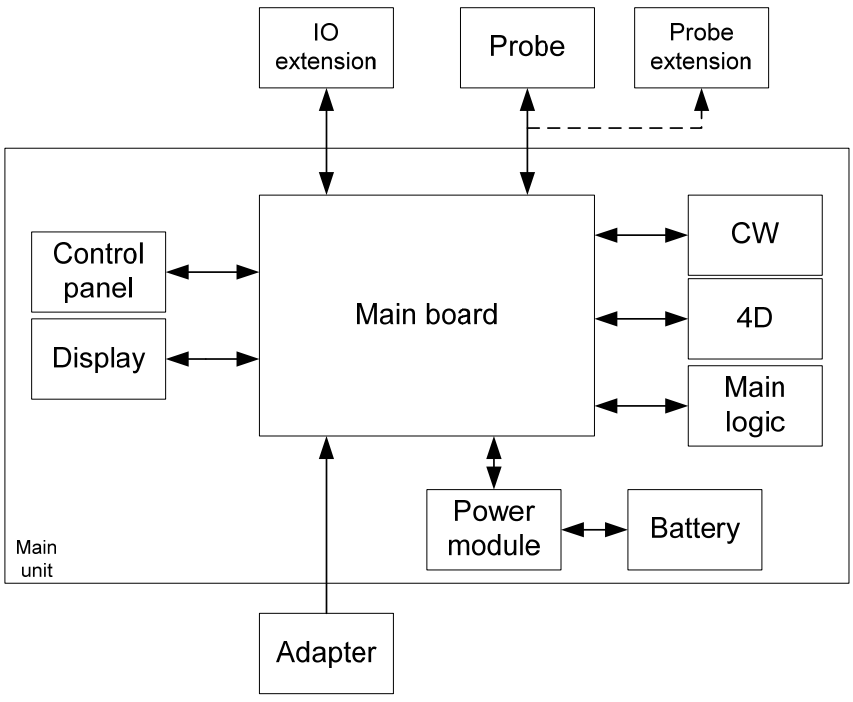


Fig 3-2 Block Diagram of the Hardware System

The main board unit is the core of the whole system, including the transducer port, transmitting, receiving, beam forming, signal processing, system monitor and management, audio, video, interfaces and so on, and these will be introduced later. Main logic unit completes the main logic processing functions, including transmitting control logic, beam former logic, signal processing logic. The functions of the other modules can be explained by their names, and will not be explained here.

Besides, M7 also supports ECG module and video capture module. Accompanied with the trolley, the transducer extend module can be used.

3.2 Principle of Boards

3.2.1 Power System

3.2.1.1 Basic Functions of Power System

As the power supply of the system, the power system consists of adapter, batteries, main power board, auxiliary power board, flexible boards for connecting batteries and flexible boards of analog power, etc. The power is supplied through two methods, external power adapter or batteries. The system is first powered by the adapter, and the batteries are provided for back-up. The main power board and auxiliary power board are mainly responsible for supplying the system with the DC output listed in the following table, charging management of the batteries, monitoring the power, and communicating with the main board.

Table 3-1 DC Output of Power Supply System

Project	Output	Board of the Function Unit	Notes
1	3V3STB	Main power board	Available when there is an adapter or dual batteries
2	5VSTB_CPU	Main power board	Controlled by 5Vstb_CPU_EN signal
3	+12V	Main power board	Controlled by POWER_ON# signal
4	+95V	Main power board	Controlled by POWER_ON# signal
5	-95V	Main power board	Controlled by POWER_ON# signal
6	PHV1P	Main power board	Controlled by POWER_ON# signal
7	PHV1N	Main power board	Controlled by POWER_ON# signal

8	PHV2P	Main power board	Controlled by POWER_ON# signal
9	PHV2N	Main power board	Controlled by POWER_ON# signal
10	+5V	Auxiliary power board	Controlled by POWER_ON# signal
11	+3.6V	Auxiliary power board	Controlled by POWER_ON# signal
12	+3.3V	Auxiliary power board	Controlled by POWER_ON# signal
13	+2.8V	Auxiliary power board	Controlled by POWER_ON# signal
14	+1.8V	Main power board	Controlled by POWER_ON# signal
15	+1.5V	Auxiliary power board	Controlled by POWER_ON# signal
16	-5V	Auxiliary power board	Controlled by POWER_ON# signal
17	-12V	Auxiliary power board	Controlled by POWER_ON# signal

3.2.1.2 Basic Principle of Power System

The principle diagram of the power system is shown in figure below. The power is supplied through two methods, external power adapter or batteries. The adapter is connected to the power board via the system main board when the system is powered by adapter. The batteries are connected to the power board via the flexible boards when the system is powered by batteries. The main power board generates 4 PHV outputs: 3V3STB, 5VSTB_CPU, +12V and ±95V, monitors and manages the power output. The auxiliary power board generates +5V, -5V, -12V, +3.6V, +3.3V, +2.8V, +1.8V and +1.5V outputs, and manages the charging of the batteries. The main power board and the auxiliary power board are connected via two 26 PIN connectors.

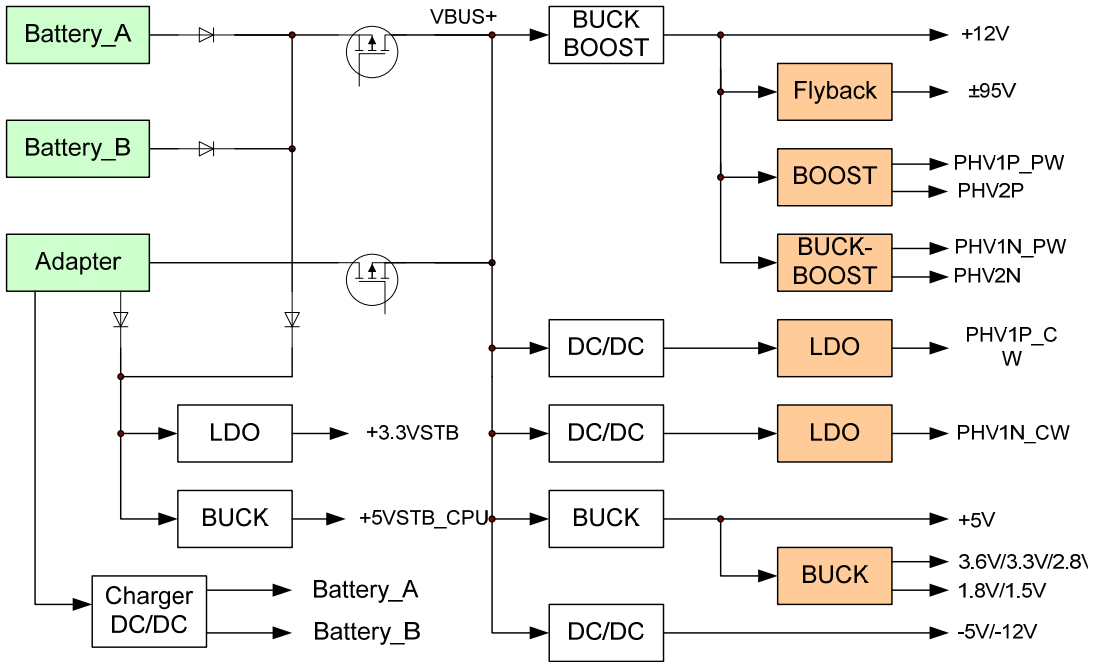


Fig 3-3 Schematic Diagram of Power System

The system main board and the digital ports of the power board are connected together via a 64 PIN connector, and the digital power ports and signals are defined in table below; the system main board and the auxiliary power board are connected together via an analog flexible board, and the analog power ports and signals are defined in

Table 3-3; the main power board and the batteries are connected together via the battery flexible board, and the signals are defined in Table 3-4; the main power board and the auxiliary power board are connected together via two 26 PIN connectors, and the signals are defined in Table 3-5 and Table 3-6.

Table 3-2 Signal definition of connectors between main power board and system main board digital power

No.	Signal name	No.	Signal name
1	EDC_PWR	2	EDC_PWR
3	EDC_PWR	4	EDC_PWR
5	EDC_PWR	6	EDC_PWR
7	GND	8	GND
9	GND	10	GND
11	GND	12	GND
13	N12V	14	STS_EDC#
15	GND	16	GND
17	POWER_ON#	18	CPU12V_OK#
19	T_D+	20	T_D-
21	GND	22	GND
23	GND	24	GND
25	D12V	26	D12V
27	D12V	28	D12V
29	GND	30	GND
31	D5V1	32	D5V1

No.	Signal name	No.	Signal name
33	GND	34	GND
35	5VSTB_OK#	36	5VSTB_EN#
37	GND	38	GND
39	5VSTB_CPU	40	3V3STB
41	GND	42	GND
43	D3V3	44	D3V3
45	GND	46	GND
47	D2V8	48	D1V5
49	GND	50	GND
51	D1V8	52	D1V8
53	GND	54	GND
55	PWR_RX	56	PWR_CONF_N
57	PWR_TX	58	PWR_RST
59	GND	60	GND
61	BATA_PRT#	62	BATB_PRT#
63	BATSTS_O	64	BATSTS_G

Signal definition

EDC_PWR: adapter power input;

GND: ground;

N12V: analog -12V output;

STS_EDC#: adapter normal working signal, low level means the output of adapter is normal;

POWER_ON#: power on signal from the system main board, low level effective;

CPU12V_OK#: +12V output signal, lower level means normal output;

T_D+, T_D-: power board temperature detecting signal;

D12V: digital power +12V output;

D5V1: digital power +5V output;

5VSTB_OK#: 5VSTB output signal, lower level means normal output;

5VSTB_EN#: 5VSTB enable signal from the system main board, low level effective;

5VSTB_CPU: standby power 5VSTB_CPU output, the voltage is +5V;

3V3STB: standby power 3V3STB output, the voltage is +3.3V;

D3V3: digital power +3.3V output;

D2V8: digital power +2.8V output;

D1V5: digital power +1.5V output;

D1V8: digital power +1.8V output;

PWR_RX: serial port communication receiving port of the the power and system mother board;

PWR_TX: serial port communication transmitting port of the power and system mother board;

PWR_CONF_N: power board chip configuration signal from the system main board;

PWR_CONF_N: power board chip reset signal from the system main board;

BATA _ PRT#: battery A presenting signal, low level means the battery is presenting;

BATA _ PRT#: battery B presenting signal, low level means the battery is presenting;

BATSTS_O: battery status indicating light, orange;

BATSTS_G: battery status indicating light, green.

Table 3-3 Signal and analog power definition between auxiliary power board and system main board

No.	Signal name	No.	Signal name
1	N95V	2	GND
3	95V	4	GND
5	PHV2N	6	GND
7	PHV1N	8	GND
9	PHV2P	10	GND
11	PHV1P	12	GND
13	A12V	14	GND
15	A2V8	16	GND
17	GND	18	GND
19	A3V6	20	A3V6
21	GND	22	GND

23	A1V5	24	A1V5
25	A1V5	26	A1V5
27	GND	28	GND
29	NA12V	30	GND
31	NA5V1	32	GND
33	GND	34	GND
35	A5V1	36	A5V1
37	A5V1	38	A5V1
39	GND	40	GND

Signal definition

N95V: -95V fixed high voltage output;

GND: ground;

95V: +95V fixed high voltage output;

PHV2N: PHV2 negative voltage output, -5~-85V;

PHV1N: PHV1 negative voltage output, PW outputs -13~-85V, CW outputs -2~-5V;

PHV2P: PHV2 positive voltage output, 5~85V;

PHV1P: PHV1 positive voltage output, PW outputs 13~85V, CW outputs 2~5V;

A12V: analog +12V output;

A2V8: analog 2.8V output;

A3V6: analog 3.6V output;

A1V5: analog 1.5V output;

NA12V: analog -12V output;

NA5V: analog -5V output;

A5V1: analog +5V output.

Table 3-4 Signal definition between the battery and main power board

No.	Signal name	No.	Signal name
1	BATB+	2	BATB+
3	BATB+	4	BATB+
5	BATB_PRT#	6	GND

No.	Signal name	No.	Signal name
7	NTC_BATB	8	GND
9	BATB_FB	10	GND
11	BATB_SCL	12	GND
13	BATB_SDA	14	GND
15	BATA_PRT#	16	GND
17	NTC_BATA	18	GND
19	BATA_FB	20	GND
21	BATA_SCL	22	GND
23	BATA_SDA	24	GND
25	GND	26	GND
27	BATA+	28	BATA+
29	BATA+	30	BATA+

Signal definition

BATB+: battery B input;

GND: ground;

BATB_PRT#: battery B presenting signal, low level is effective;

NTC_BATB: battery B temperature signal;

BATB_FB: battery B far end sampling signal;

BATA_SCL: battery B SMBUS communication clock signal;

BATA_SDA: battery B SMBUS communication data signal;

BATA_PRT#: battery A presenting signal, low level is effective;

NTC_BATA: battery A temperature signal;

BATA_FB: battery B far end sampling signal;

BATA_SCL: battery A SMBUS communication clock signal;

BATA_SDA: battery A SMBUS communication data signal;

BATA+: battery A input;

Table 3-5 Signal definition between main power board and auxiliary power board

No.	Signal name	No.	Signal name
1	VBUS+	2	VBUS+
3	VBUS+	4	GND
5	GND	6	GND
7	5V_CW	8	D5V1
9	START	10	D2V8
11	GND	12	GND
13	N5V_CW	14	A12V
15	GND	16	N12V
17	PHV2P	18	D1V5
19	PHV1P	20	GND
21	PHV2N	22	GND
23	PHV1N	24	GND
25	95V	26	N95V

Signal definition

VBUS+: input bus voltage on the power board;

GND: ground;

5V_CW: LDO input of PHV1P CW voltage;

D5V1: digital power +5V output;

START: auxiliary power board power on signal from the system main board, low level effective;

D2V8: digital power +2.8V output;

5V_CW: LDO input of PHV1N CW voltage;

A12V: analog +12V output;

N12V: digital power -12V output;

PHV2P: PHV2 positive voltage output, 5~85V；

D1V5: digital power +1.5V output;

PHV1P: PHV1 positive voltage output, PW output 13~85V, CW output 2~5V;

PHV2N: PHV2 negative voltage output, -5~85V；

PHV1N: PHV1 negative voltage output, PW output -13~85V, CW output -2~5V;

95V: +95V fixed high voltage output;

N95V: -95V fixed high voltage output.

Table 3-6 Signal definition between main power board and auxiliary power board (2)

No.	Signal name	No.	Signal name
1	EDC_POWER	2	EDC_POWER
3	ISENSE	4	EDC_POWER
5	GND	6	GND
7	CHARGE_EN	8	GND
9	BATA+	10	BATA+
11	BATA_FB	12	NTC_BATA
13	GND	14	GND
15	BATB_FB	16	NTC_BATB
17	BATB+	18	BATB+
19	GND	20	GND
21	D1V8	22	D1V8
23	GND	24	GND
25	D3V3	26	D3V3

Signal definition

EDC_PWR: adapter power input;

ISENSE: main system load current signal from the power main board to the auxiliary power board;

GND: ground;

CHARGE_EN: battery charge enable signal, low level effective;

BATA+: battery A input;

BATA_FB: battery A far end sampling signal;

NTC_BATA: battery A temperature signal;

BATB_FB: battery B far end sampling signal;

NTC_BATB: battery B temperature signal;

BATB+: battery B input;

D1V8: digital power +1.8V output;

D3V3: digital power +3.3V output.

3.2.1.3 3V3STB Circuit Unit

Basic Principle of 3V3STB Circuit

The 3V3STB takes EDC_POWER from the adapter or the BATTERY_BUS from the batteries as the input and generates 3V3STB via linear voltage-stabilizing chip TPS715A01.

TPS715A01 is equipped with current-limiting function itself.

The Maintenance Points of 3V3STB Circuit

If the 3V3STB unit is faulty, first check whether the input voltage of U12 PIN1 is normal; if it is normal, it indicates that the U12 is damaged or the fault is caused by the over-current or short circuit of the load.

3.2.1.4 5VSTB_CPU Circuit Unit

Basic Principle of 5VSTB_CPU Circuit

The 5VSTB_CPU takes the BATTERY_BUS from the batteries as input and generates the output via the synchronous rectifying step-down chip TPS62110 through BUCK transformation.

The TPS62110 chip itself is equipped with MOSFET, current-limiting function and over-temperature protection.

The Maintenance Points of 5VSTB_CPU Circuit

If the 5VSTB_CPU unit is faulty, first check whether the input voltage of U35 PIN2 is normal and whether the enabling signal of PIN4 is 3.3V; if they are all normal, it indicates that the U35 is damaged or the fault is caused by the over-current or short circuit of the load; if PIN4 is low level, check whether the system main board provides 5VSTB_EN# signal and whether the feedback connection or overvoltage circuit is normal.

3.2.1.5 +12V Circuit Unit

Basic Principle of +12V

Voltage rise-and-fall IC LTC3780 of LINEAR Company is applied in +12V circuit unit, and whether the input voltage is higher or lower than 12V, the output voltage will be kept at 12V.

The +12V over-current and overvoltage protection is not locked, and the over-current is over 8A. The output voltage returns to normal after over-current disappears.

The Maintenance Points of +12V

Before testing, ensure that the POWER_ON# signal is of low level and the input voltage VBUS+ is normal.

The work flow of maintenance is shown as follows:

Test the voltage of PIN8 of U14, which should be higher than 3V;

Test the voltage of PIN19 of U14, which should be higher than 6V;

Use an oscilloscope to measure G poles of Q6, Q7, Q8 and Q9 to check whether there is driving pulse; at least two MOSFETs' G poles should have drive pulse;

Check if there is any damage to the four MOSFETs Q6, Q7, Q8 and Q9 and diode D5 and D7;

If +12V hiccups, check whether the output is overloaded, and check the feedback and overvoltage protection circuits.

3.2.1.6 PHV Circuit Unit

Basic Principle of PHV

The PHV circuit consists of PHV1P, PHV1N, HV2P and PHV2N, of which, the PHV1P and PHV1N consist of PW and CW output. The PW output range of PHV1 is ±13V~±85V, and the CW output range is ±2V~±4V. Only PW output of PHV2 is available, and the output range is ±5V~±85V.

The input of the PW circuit of the 4 PHVs is controlled +12V, which is under the control of PMOS Q5.The PW output voltage of PHV1P and PHV2P is generated by BOOST circuit. The controlling IC is TL594, which is frequently adopted by our company. The range of output voltage of PHV2P is +5V~+85V, so when the output voltage is over than 15V, the input is +12V; and when the output voltage is lower than 15V, the input is +5V. Both the two inputs are under the control of output voltage controlling signal. The PW output voltage of PHV1N and PHV2N is generated by BUCK-BOOST circuit. The controlling IC is MAX1847, which is frequently adopted by our company.

The CW output of PHV1P and PHV1N is generated through linear voltage-stabilizing. The input of CW circuit of PHV1P is +5V and the chip LT1963 LDO is adopted for the linear voltage-stabilizing; the input of CW circuit of PHV1N is -5V, and the chip LT1185 LDO is adopted for the linear voltage-stabilizing. The voltage of CW output is regulated by the output voltage controlling signal. When the controlling signal is 0.45~2.25V, the corresponding output voltage is ±2V~±4V.

The 4 PHV are all equipped with overvoltage protection, and the overvoltage protection of each circuit is independent. The overvoltage will not be locked, and the voltage is about 93V when overvoltage occurs.

The 4 PHV are all equipped with over-current protection. In PW mode, once over-current occurs, all the 4 PHV PW outputs and ±95V will be switched off, while the CW output is not influenced. The

over current protection in CW mode is implemented by current-limiting of LDO chip itself. Only the output is cut off and other outputs are not influenced.

The Maintenance Points of PHVP PW Circuit Unit

Make sure the +12V output is normal, and PHV_CW is low level before testing.

Test the grid electrode of Q5, and the voltage should be around 3V and VCC2 is 12V.

The work flow of troubleshooting for U17 and U18 and their peripheral circuits are shown as follows:

Test the voltage of PIN8 and PIN11, which should be 12V;

Test the voltage of PIN14, which should be +5V;

Test PIN5, and there should be oscillation wave form, the frequency of which is around 100kHz;

Test the voltage of PIN15, which should be around 5V;

Test PIN9 and PIN10, and there should be driving pulses.

If the test shows the grid electrode of Q5 is 12V, check the +5V output and whether over-current or short circuit occurs.

The Maintenance Points of PHVN PW Circuit Unit

Make sure the +12V output is normal, and PHV_CW is low level before testing.

Test the grid electrode of Q5, and the voltage should be around 3V and VCC2 is 12V.

The work flow of troubleshooting for U24 and U25 and their peripheral circuits are shown as follows:

Test the voltage of PIN15, which should be 12V;

Test the voltage of PIN5, which should be +1.25V;

Test the voltage of PIN2, which should be around 4.25V;

Test PIN14, and there should be driving pulses.

If the test shows the grid electrode of Q5 is 12V, check the +5V output and whether over-current or short circuit occurs.

The Maintenance Points of PHV CW Circuit Unit

Make sure the +5V and -5V outputs are normal, and PHV_CW is high level before testing;

The work flow of troubleshooting for U13 and its peripheral circuit is shown as follows:

Test the voltage of PIN12, which should be +5V;

Test the voltage of PIN6, which should be +1.21V;

If the output voltage is not consistent with the controlling signal, check R66, R203, R260, R150 and U2 related circuits.

The work flow of troubleshooting for U31 and its peripheral circuits are shown as follows:

Test the voltage of PIN3, which should be -5V;

Test the voltage of PIN2, which should be -2.37V;

If the output voltage is not consistent with the controlling signal, check R67, R204, R198 and U3 related circuits.

3.2.1.7 +5V Circuit Unit

Basic Principle of +5V Circuit

The input of +5V circuit is VBUS+, and stable +5V output is generated through BUCK transformation step-down. The controlling IC is LM5642 from NS, which is a biphase step-down synchronously rectifying controlling IC.

+5V circuit is equipped with overvoltage and over-current protection and is locked during protection.

The Maintenance Points of +5V Circuit

Check by sight whether LM5642 and its peripheral devices are well welded before power on, and check whether the MOSFETs Q16~Q19 and diodes D3 and D6 are broken down using a multimeter.

Before testing, make sure that the STRAT signal is free or of low level, and the input voltage VBUS+ is normal.

The work flow of maintenance after power on is shown as follows:

Test the voltage of PIN22, which should be VBUS+;

Test the voltage of PIN7, PIN19 and PIN25, which should be around +5V;

Test PIN9 and PIN10, which should be over than 1V;

Test PIN17, PIN20, PIN23 and PIN26, and there should be driving pulses at the frequency of around 200kHz;

If there is no output with the circuit, check whether the output is over-current and check the feedback circuit.

3.2.1.8 +1.5V Circuit Unit

Basic Principle of +1.5V Circuit

+1.5V output adopts the synchronously rectifying step-down chip EL7566, which is frequently adopted by our company. This chip is integrated with over-current and over-temperature protection internally. The over-current protection protects from hiccup.

The Maintenance Points of +1.5V Circuit Unit

Check by sight whether EL7566 and its peripheral devices are well welded before power on. The work flow after power on is:

Test the voltage of PIN19~PIN21, which should be +5V;

Test the voltage of PIN22, which should be +5V;

Test PIN27, which should have oscillatory wave output;

Test PIN8~PIN13, which should have pulse voltage waveform;

If there is no output with the circuit or the if circuit is hiccupping, check if the output is over-current and check the feedback circuit.

3.2.1.9 +3.6V/3.3V/2.8V/1.8V Circuit Unit

Basic Principle of +3.6V/3.3V/2.8V/1.8V Circuit

The output adopts the synchronously rectifying step-down chip LM2854 of NS Corporation. This chip is integrated with MOSFET and over-current protection internally. The over-current protection protects from hiccup.

The Maintenance Points of +3.6V/3.3V/2.8V/1.8V Circuit Unit

Check by sight whether LM2854 and its peripheral devices are well welded before power on. The work flow after power on is:

Test the voltage of PIN5~PIN7 and PIN10~11, which should be +5V;

Test PIN12~PIN13, which should have pulse voltage waveform;

If there is no output with the circuit or if the circuit is hiccupping, check if the output is over-current and check the feedback circuit.

3.2.1.10 -5V and -12V Circuit Unit

Basic Principle of -5V and -12V

The implementations of -5V and -12V are the same. The negative voltage IC MAX1847 is adopted for both circuits. The -5V and -12V are both equipped with overvoltage and over-current protection circuits, so once either overvoltage or over-current occurs, both circuits will be cut off and locked.

The Maintenance Points of -5V and -12V Circuits

Make sure that VBUS+ for -5V and -12V is within the normal range.

After power on, refer to the work flow shown as follows:

Test the voltage of PIN15 of the power supply chip U15~16, which should be the same as VBUS+;

Test the voltage of PIN5 (the reference voltage pin), which should be 1.25V;

Test PIN8, the overvoltage and over-current protection controlling pin, which should be higher than 2V;

Test PIN14 (drive pin), which should output drive pulse.

If there is no output with the circuit, check if the output is over-current and check the feedback circuit.

3.2.1.11 Charging Unit

Basic Principle of Charging Unit

The rise-and-fall charging chip MAX1870A made by MAXIM is adopted for both charging units A and B.

The MAX1870A enabling is controlled by the system's main board and batteries' temperature, and eventually controlled by level of PIN15. When PIN15 is high level (about 5V), the charging is enabled; when PIN15 is low level, the charging is disenabled. The charging current is affected by the status of the batteries and the load current of the main unit. The charging circuit regulates the charging current dynamically according to the load current of the main unit to ensure fast charging and the load current of the adapter is not overloaded when the system is on.

The Maintenance Points of Charging Unit

Before testing, ensure that the charging chip is enabled, that is, PIN15 is high level.

The maintenance work flow of charging IC U7 and U8 and their peripheral circuits.

Check by sight if the soldering position departs from normal position, if so, it will cause short circuit of pins.

Test power supplying voltage PIN32, which should be equal to adapter's output voltage of EDC_POWER.

Test reference end's PIN2, which should be about 4.0V.

Test linear stabilizing output PIN1, which should be 5.4V.

Test the voltage difference between PIN28 and PIN30, which should be less than 90mV.

Test driving pin PIN27 and PIN22, and at least one PIN should have driving pulse output.

Test if there is any damage to the power device MOS semiconductor and diode.

±95V circuit.

Basic Principle of ±95V Circuit

±95V is generated from +12V through the non-isolated reverse converter, the chip is UC3843B of ONSEMI.±95V output is figured with overvoltage, over-current and short circuit protection, it will not be locked in the case of overvoltage, and be locked during over-current and short circuit protection.

The Maintenance Points of ±95V Circuit

First check if +12V output voltage is within the normal range, and if START signal is low level.

After power on, refer to the work flow shown as follows:

Test PIN8 of U1, the voltage should be +5V;

Test PIN4 of U1, there should have triangular wave of about 130 kHz;

Test PIN4 of U1, there should have drive pulse output;

Test PIN3 of U1, there should have triangular wave with the amplitude less than 1V.

If there is no output with the circuit, check if the output is over-current, check the feedback circuit, meanwhile, check if PHV_OCP is high level.

3.2.2 Principle of the Main Board

The schematic diagram of the main board is shown in figure below.

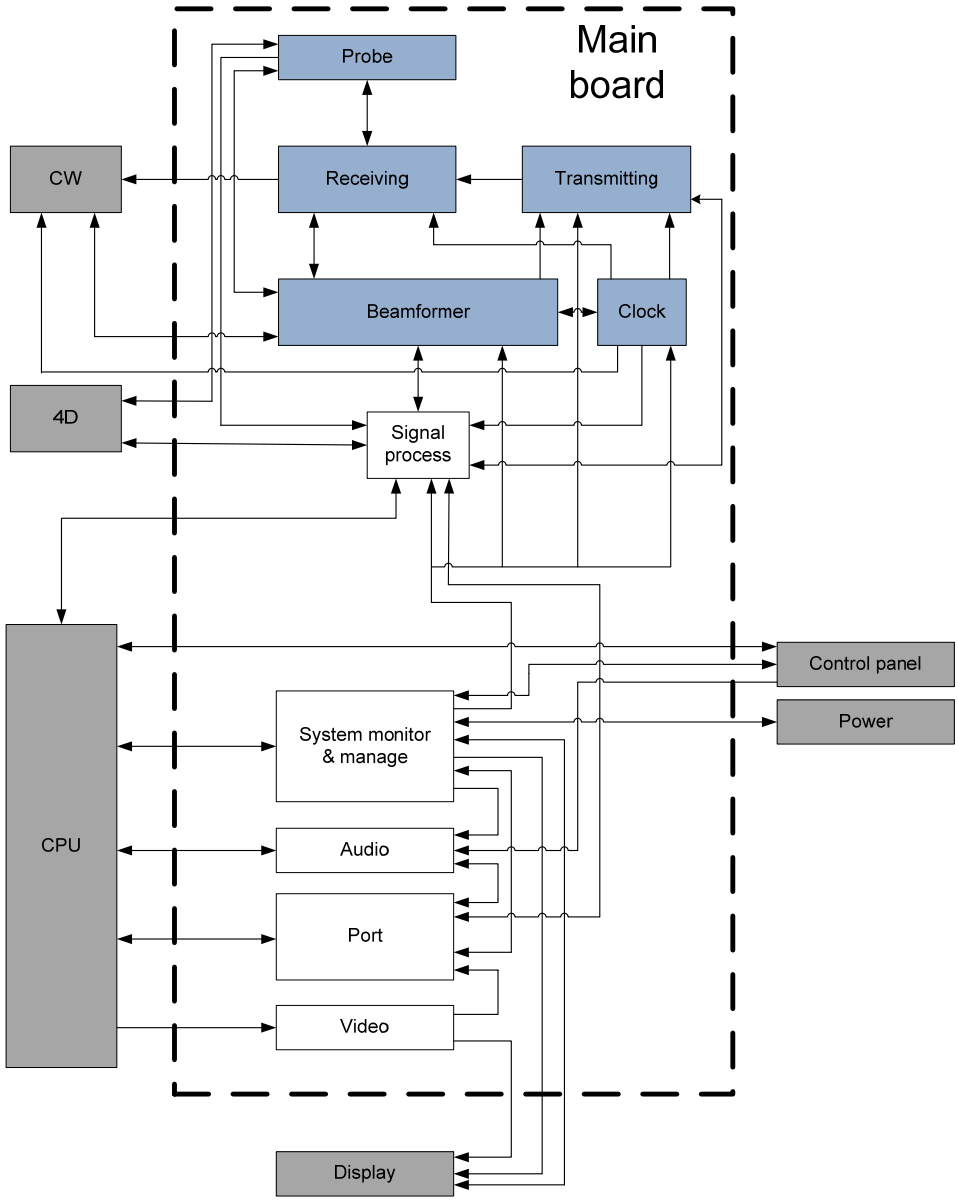


Fig 3-4 Principle Diagram of Main Board

As shown in figure above, the main board unit is mainly configured with the following functional modules:

Transducer sockets;

Ultrasound receiving;

Ultrasound transmission;

Beam forming;

System clock;

Signal processing;

System monitoring and managing;

Audio;

Video;

IO ports;

Where, the transducer sockets, ultrasound transmission and receiving, beam forming and system clock are categorized as analog power region. The signal processing, signal monitoring and managing, audio, video and I/O ports are categorized as digital power region.

The main board provides the interfaces for:

Transducer board;

Transmission board;

CW board;

4D board;

Keyboard board;

Flexible board for connecting the batteries;

CPU module;

LVDS display ports;

Power supply module;

Hard disk;

Reserved power interfaces;

Reserved signal interfaces;

Fan;

Speaker.

External interfaces include:

S_Video;

Network;

USB (2);

Extend interface.

The layout of the above-mentioned module interfaces in the main board is shown in figure below.

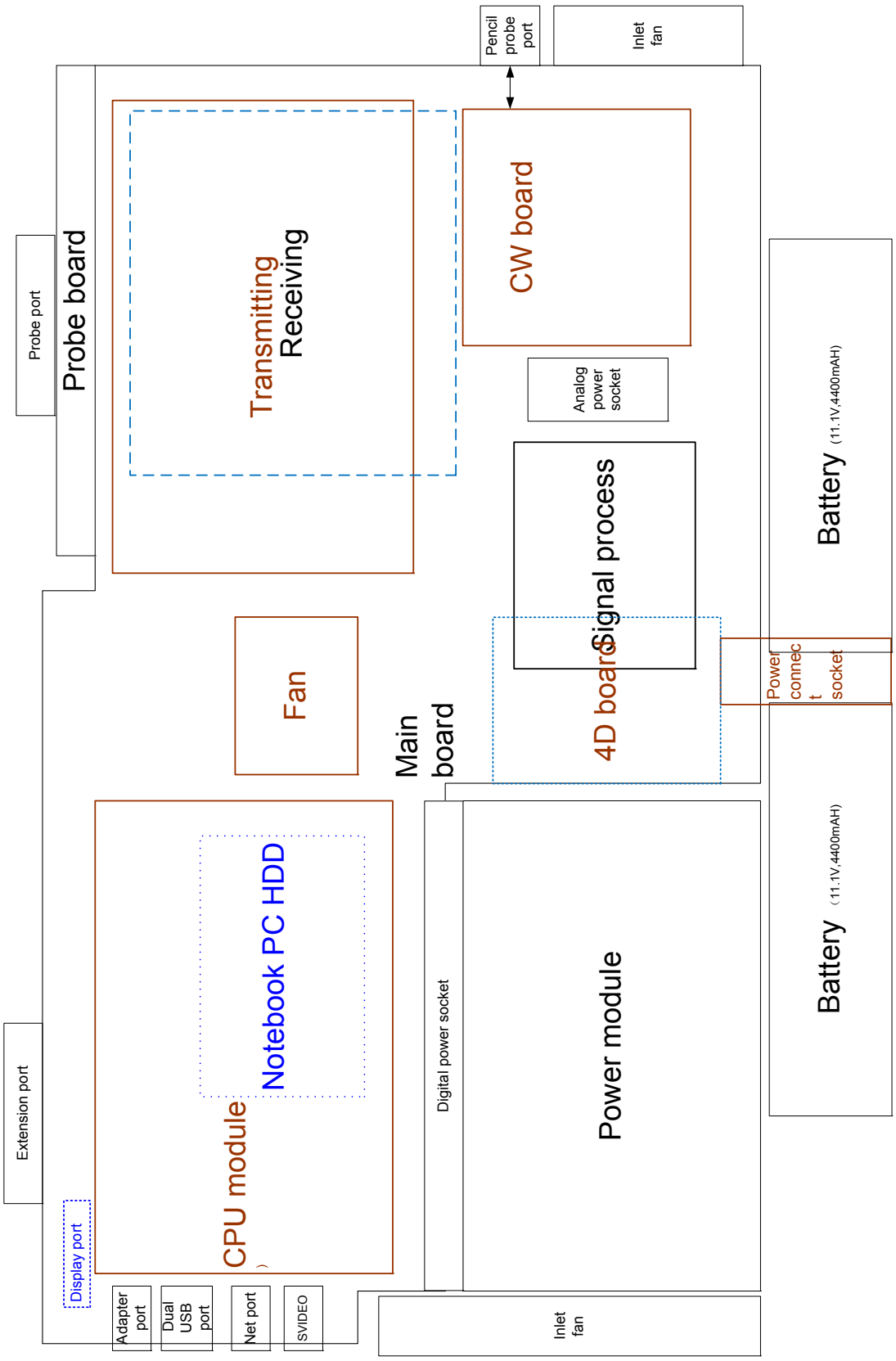


Fig 3-5 Layout of Each Module and Socket on the Main Board

3.2.2.1 Power Distribution

The power distribution of M7 is an enormous network, refer to the following two figures for the detailed distribution.

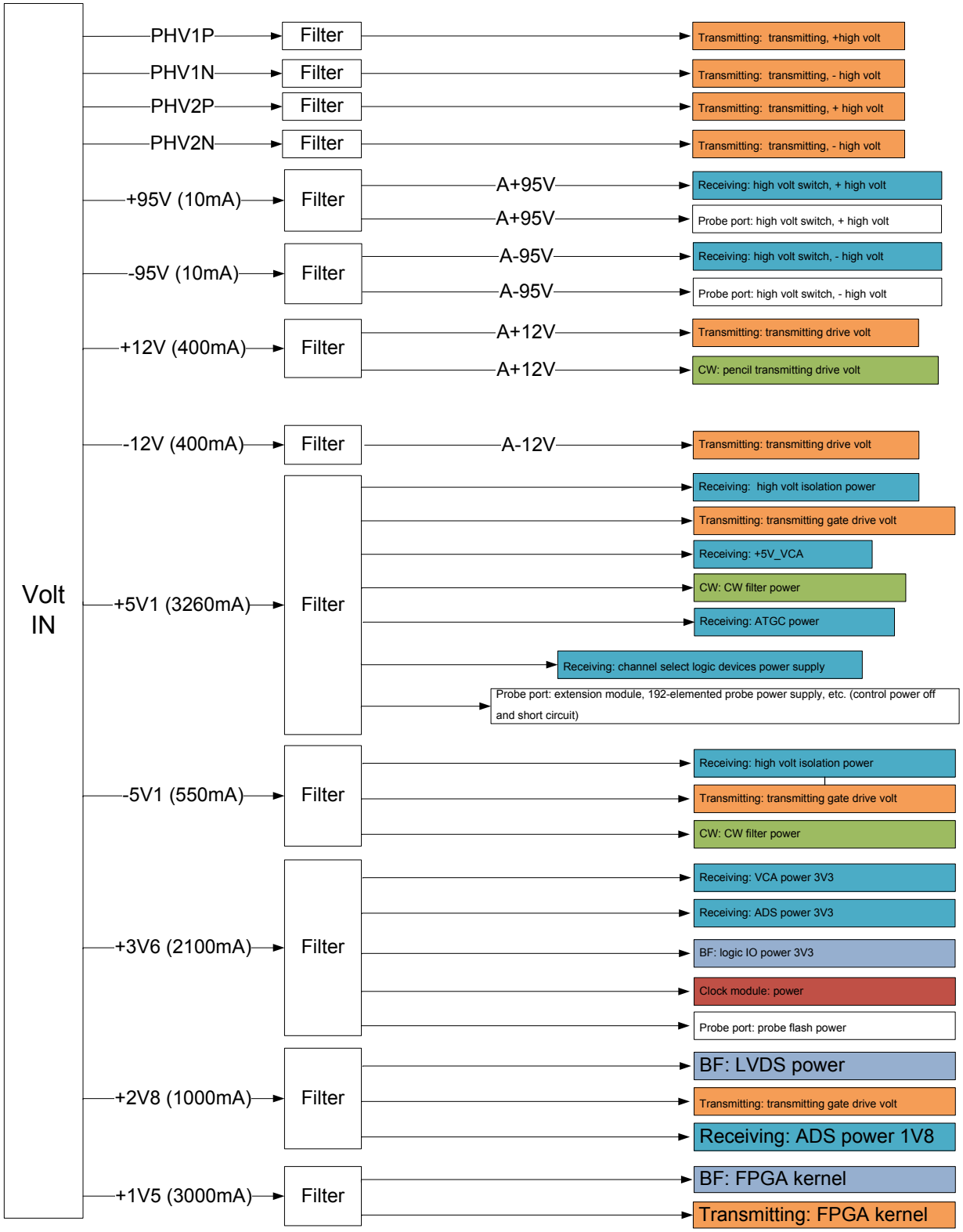


Fig 3-6 Front-end Power Tree of the Main Board

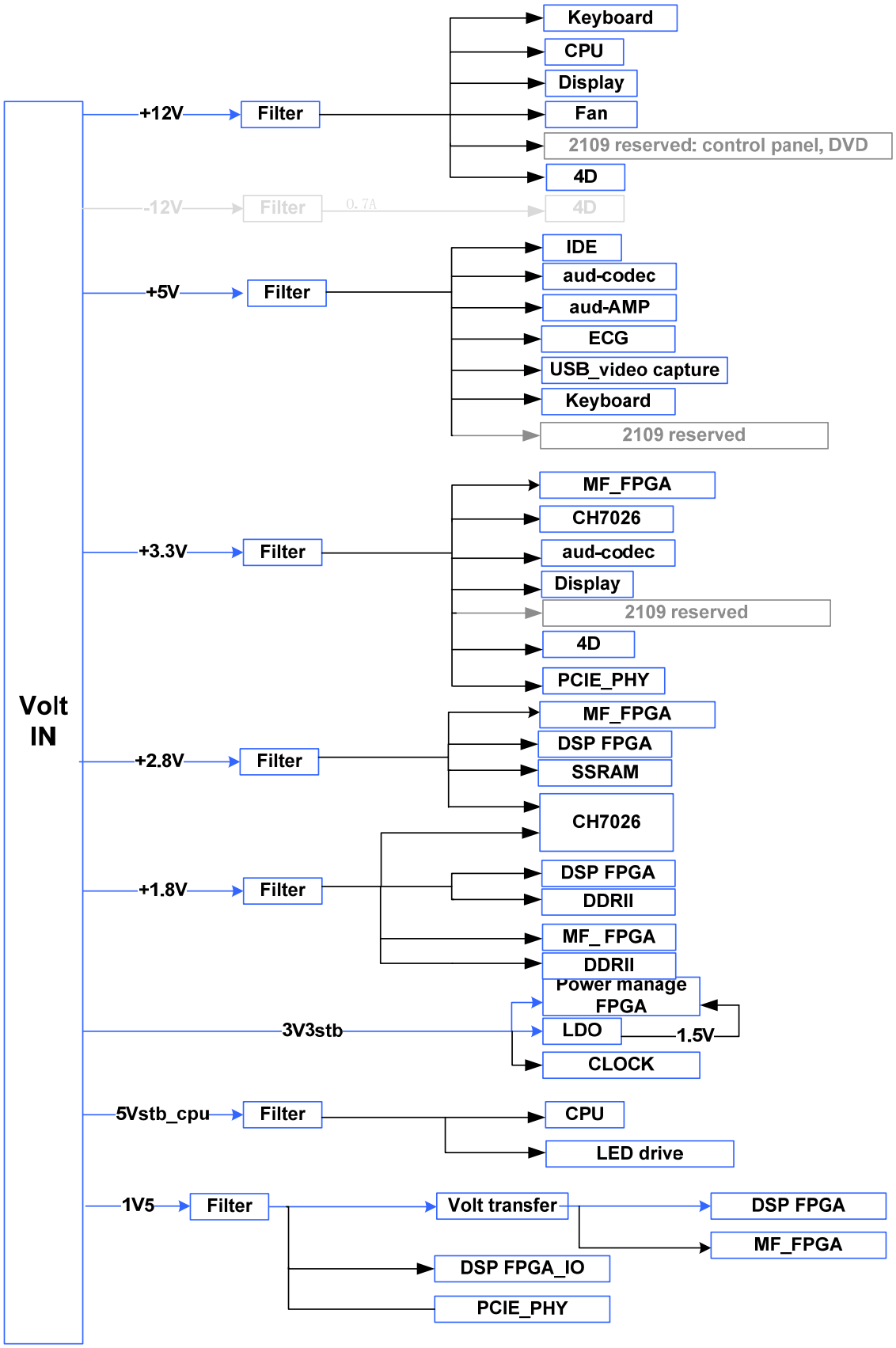


Fig 3-7 Back-end Power Tree of the Main Board

3.2.2.2 Ultrasound Receiving

The basic structure of the front-end circuit is shown in figure below:

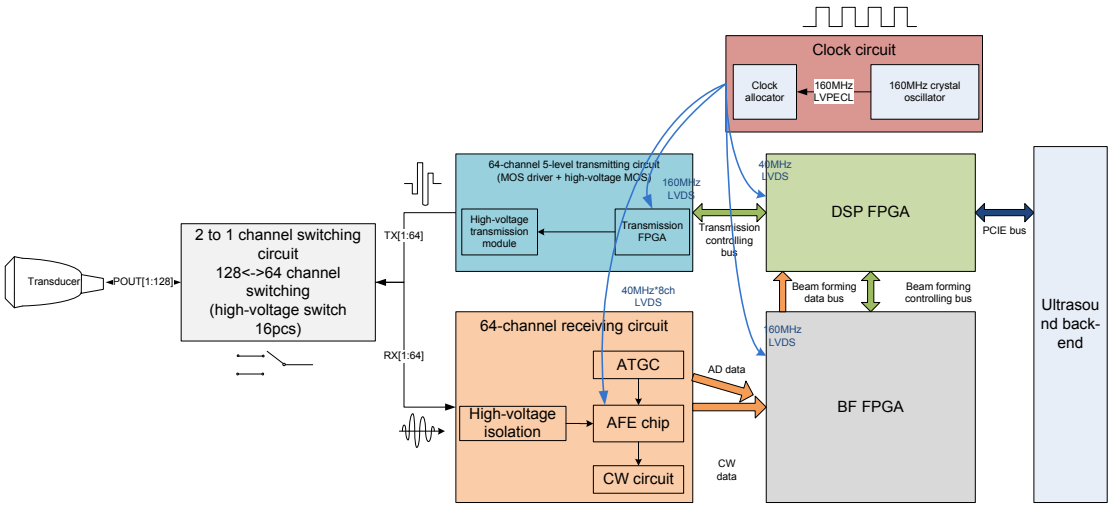


Fig 3-8 Diagram of Front-end Circuit

The receiving circuit of the main board consists of channel switching and receiving circuits.

Channel switching circuit

Transmitting and receiving circuits are 64 channels, but the actual transducer is 128 channels, so channel switching circuit is needed to switch the 64 channels of the transmitting and receiving into 128 channels. 8 channel conversion circuit is completed through 16-channel high voltage switch chip. Refer to the principle diagram for the principle.

Receiving circuit

The receiving circuit consists of high-voltage isolation circuit, voltage-controlled gain amplification circuit and high-speed ADC.

The high-voltage isolation circuit protects the receiving amplification circuit during transmission from high-voltage transmission pulse damage.

Voltage-controlled gain amplification circuit amplifies weak ultrasound echoes and transmits them to ADC for analog-to-digital conversion. It converts ultrasound echoes to digital signals for succeeding digital processing.

Voltage-controlled amplification circuit and high-speed ADC are all integrated in one AFE chip in M7.An AFE chip consists of 8-channel voltage-controlled gain amplification circuit and high-speed ADC. There are 8 AFEs in M7, composing 64 receiving channels.

3.2.2.3 Clock Circuit

The clock circuit provides low phase noise clock to the above-mentioned modules.

The clock circuit consists of crystal oscillator and clock allocator. The crystal oscillator is a 160Mhz oscillator with good phase noises. It distributes the clock signals via the clock allocator. The clock allocator has 12 LVDS outputs, and each one can split the frequency independently.

The outputs of the clock circuit are shown in figure below:

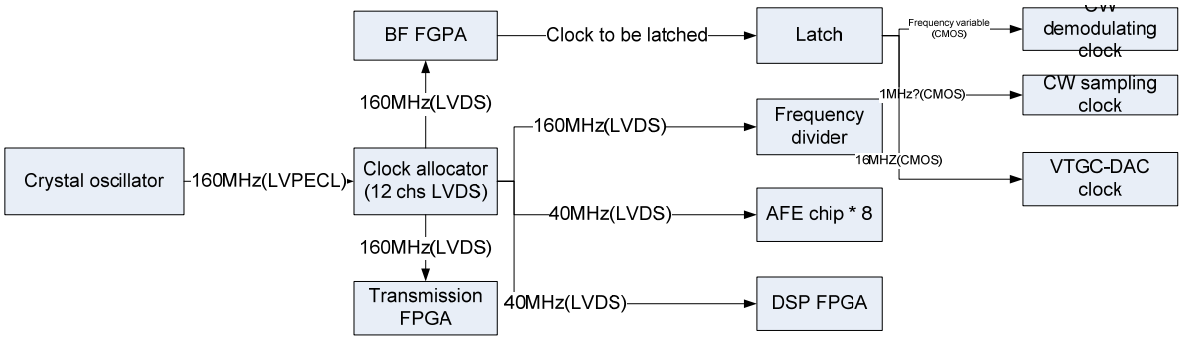


Fig 3-9 Diagram of Clock Circuit

3.2.2.4 Signal Processing

The signal processing is mainly implemented through two FPGAs: FPGA1 and FPGA2.

The FPGA1 mainly responsible for controlling on the front-end chips (such as channel selection CPLD, VGA gain control DAC, ADC, transducer and transducer extend module), beam forming, and orthogonal demodulation, generating transmission sequence pulse, etc.

The FPGA2 implements signal processing, data uploading, real time scan parameters loading, 4D controlling, etc. Data is uploaded through PCIE interface.

3.2.2.5 Power Management

Power management is basically implemented by the power management FPGA.

System power can be sorted as STANDBY power, CPU STANDBY power and normal working power in terms of power-on sequence.

STANDBY power is provided in the status of system POWERDOWN, including 3V3STB and 1V5_FPGA.These power supplies are mainly for powering the power managing FPGA devices for power management. The power of power managing FPGA reset signal, 10k crystal oscillator, power managing FPGA, CPU12V_OK and CPU5VSTB_OK, etc. As long as the adapter is connected or batteries are loaded, they will be powered.

CPU STANDBY power is required in the POWER DOWN status of PC module, including 5VSBY and 3V3_STB_CPU.In the system is POWER DOWN, this power is turned off. Turn on this power before starting the PC system.

The working power is provided when the system is working normally. Except the two types of powers mentioned above, other powers all belong to working powers. The following indicators are used for the working powers:

Table 3-7 Power indicators on main board

No.	LED Number	Meaning
1	D227	12V
2	D18	VCC
3	D17	VDD

There are some indicators on the control panel for indicating power status. The signals are described in the following table:

Table 3-8 Indicators on the control panel

No.	Indicator	Drive signal	Definition	Notes
1	Work Status LED	WORKSTS_O	Dual-color, indicating the current status of the main unit: It remains off when the system is turned off. Press POWERBTN, the light flashes in green when S3# is disenabled. When S3# is disenabled after system power on, the light turns into green.	
		WORKSTS_G		
2	EDC Status LED	EDCSTS_G	Single color, indicating if the main unit is connected with the mains power: When disconnected, the light is off, otherwise, in green.	
3	Battery Status LED	BATSTS_O	Dual-color, indicating the current battery status: It illuminates in orange color when battery is charging; It illuminates in green color when battery is charging to full capacity; It flashes in orange color if battery	
		BATSTS_G		

No.	Indicator	Drive signal	Definition	Notes
			capacity is less than 30%, the battery is discharging, and the system is working; It flashes in green color if battery capacity is more than 30%, the battery is discharging, and the system is at standby status; It flashes in green and orange alternately if battery capacity is less than 30%, the battery is discharging, and the system is at standby status; The light flashes in orange at the cycle of 0.5S, that is to say, 0.25S on, and 0.25S off. The light flashes in green at the cycle of 1S, that is to say, 0.5S on, and 0.5S off. When the light flashes in in green and orange alternately, the green light is 0.25S on and 0.25S off; the orange light is 0.25S on and 0.25S off.	

3.2.2.6 System Monitoring

The system monitoring includes voltage monitoring, temperature monitoring and fan rotating control.

Monitor on the voltage: direct measurement, including measurement of 12V, N12V, VCC, VDD, 1.5V, 2.8V, 1.8V and 1.2V;

It detects power board and front-end temperature.

Monitors and controls on fans and ventilation unit.

3.2.2.7 Video Processing

There are two versions for M7 video processing:

The first version:

On the PCBA of the main board 051-000098-00 VA, 051-000098-01 V1－V4, the following method is adopted:

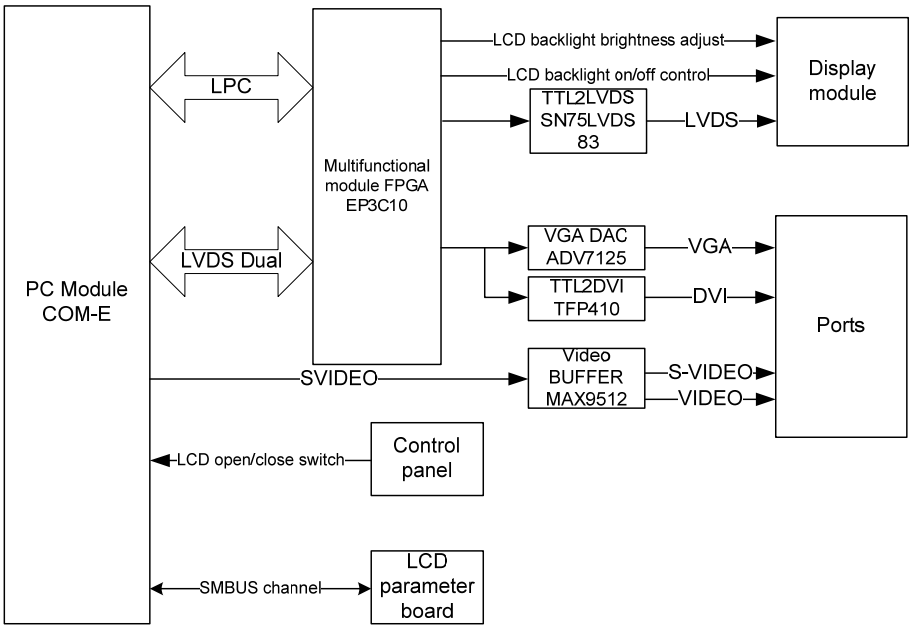


Fig 3-10 Block diagram of video module (the first version)

Of which, the video signals of LVDS, VGA, and DVI are all from LVDS of PC module.

Both S-VIDEO and VIDEO are generated by SVIDEO of PC module.

The display switch is on the control panel.

The display parameters are saved in EEPROM of LCD parameter board, they are accessed by SMBUS of the PC module.

The second version:

On the PCBA of the main board 051-000098-02 V1, the following method is adopted:

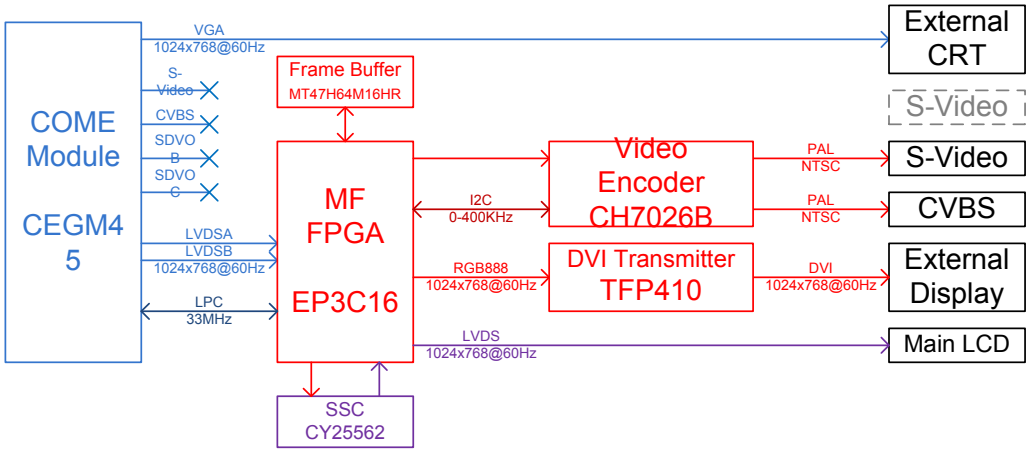


Fig 3-11 Block diagram of video module (the second version)

External display video signal is generated from VGA of PC module.

S-Video, CVBS, DVI, and LVDS video signals are all generated from LVDS of PC module.

The display switch is on the control panel.

The display parameters are saved in EEPROM of LCD parameter board, they are accessed by SMBUS of the PC module.

3.2.2.8 Interfaces of Main Board

Interfaces of Main Board and Transducer Board

Signals of the main board and transducer board are defined in table below.

Table 3-9 Interfaces of the main board and transducer board

CON1						CON2					
PIN	PIN NAME	PIN	PIN NAME	PIN	PIN NAME	PIN	PIN NAME	PIN	PIN NAME	PIN	PIN NAME
1	GND	2	POUT1	3	GND	1	POUT69	2	POUT70	3	POUT71
4	POUT2	5	GND	6	POUT3	4	POUT72	5	POUT73	6	POUT74
7	GND	8	POUT4	9	POUT5	7	POUT75	8	GND	9	POUT76
10	POUT6	11	POUT7	12	GND	10	GND	11	POUT77	12	POUT78
13	POUT8	14	GND	15	POUT9	13	POUT79	14	POUT80	15	GND
16	GND	17	POUT10	18	POUT11	16	POUT81	17	GND	18	POUT82
19	POUT12	20	POUT13	21	GND	19	GND	20	POUT83	21	POUT84
22	POUT14	23	GND	24	POUT15	22	POUT85	23	POUT86	24	GND
25	GND	26	POUT16	27	POUT17	25	POUT87	26	GND	27	POUT88
28	POUT18	29	POUT19	30	GND	28	GND	29	POUT89	30	POUT90
31	POUT20	32	GND	33	POUT21	31	POUT91	32	POUT92	33	GND
34	GND	35	POUT22	36	POUT23	34	POUT93	35	GND	36	POUT94
37	POUT24	38	POUT25	39	GND	37	GND	38	POUT95	39	POUT96
40	POUT26	41	GND	42	POUT27	40	POUT97	41	POUT98	42	GND
43	GND	44	POUT28	45	POUT29	43	POUT99	44	GND	45	POUT100
46	POUT30	47	POUT31	48	GND	46	POUT101	47	POUT102	48	POUT103
49	POUT32	50	GND	51	POUT33	49	POUT104	50	POUT105	51	GND
52	GND	53	POUT34	54	POUT35	52	POUT106	53	GND	54	POUT107
55	POUT36	56	POUT37	57	GND	55	GND	56	POUT108	57	POUT109
58	POUT38	59	GND	60	POUT39	58	POUT110	59	POUT111	60	POUT112
61	GND	62	POUT40	63	POUT41	61	POUT113	62	GND	63	POUT114

CON1						CON2					
64	POUT42	65	POUT43	66	GND	64	POUT115	65	POUT116	66	POUT117
67	POUT44	68	GND	69	POUT45	67	POUT118	68	POUT119	69	GND
70	GND	71	POUT46	72	POUT47	70	POUT120	71	GND	72	POUT121
73	POUT48	74	POUT49	75	GND	73	GND	74	POUT122	75	POUT123
76	POUT50	77	GND	78	POUT51	76	POUT124	77	POUT125	78	POUT126
79	GND	80	POUT52	81	POUT53	79	POUT127	80	GND	81	POUT128
82	POUT54	83	POUT55	84	GND	82	PROBE_SPICLK	83	PROBE_SPICS_N	84	PROBE_SPIDIN
85	POUT56	86	GND	87	POUT57	85	PROBE_SPIDOUT	86	PROBE_FLASH_WP_N	87	PRB_DP_FREEZE_N
88	GND	89	POUT58	90	POUT59	88	A+3V3_PRB	89	GND	90	A+85V_PROBE
91	POUT60	92	POUT61	93	GND	91	PROBE_PLUG	92	CLK_192_PROBE	93	DIN1_192_PROBE
94	POUT62	95	GND	96	POUT63	94	DIN2_192_PROBE	95	LE_N_192_PROBE	96	A-85V_PROBE
97	GND	98	POUT64	99	POUT65	97	EXPRESS_PRESENT_N	98	PRB_DP_SWITCH_N	99	PROBE_PRESENT_N
100	POUT66	101	POUT67	102	GND	100	GND	101	GND	102	GND
103	GND	104	GND	105	POUT68	103	A+5V_PROBE	104	A+5V_PROBE	105	A+5V_PROBE

The signals are described in the following table:

Table 3-10 Interface & signals of main board and transducer board

SIGNAL NAME	DESCRIPTION
POUT[1:128]	Transmitting signals and receiving echo signals
SPIDIN_PROBE	Probe Flash SPI Data IN
SPIDOUT_PROBE	Probe Flash SPI Data OUT
SPICS_N_PROBE	Probe Flash SPI CS_N
SPICLK_PROBE	Probe Flash SPI CLOCK

SIGNAL NAME	DESCRIPTION
FLASH_WP_N_PROBE	Probe Flash Write Protect
FLASHSPIOE_N_PROBE	Probe Flash SPI enable
CTRL_A+3V3_PROBE_N	Enable Flash power of transducer
CTRL_A+5V_PROBE	Enable transducer extend power
PRB_PRESENT	Transducer present signal
EXP_PRESENT	Transducer extend module present signal
192_CLK_PROBE	High-voltage switch clock of 192-elemented transducer
192_LE_N_PROBE	Enabling signal of 192-elemented transducer high-voltage switch
192_DIN1_PROBE	High-voltage switch data 1 of 192-elemented transducer
192_DIN2_PROBE	High-voltage switch data 2 of 192-elemented transducer
192_SPIOE_N_PROBE	Enabling SPI of 192-elemented transducer
CTRL_192HV _PROBE	Control high-voltage output of 192 transducer
PRB_DP_FRZ	FREEZE signal of real-time bi-planar transducer
PRB_DP_SW	Switching signal of real-time bi-planar transducer
PRB_PLUG_N	Detection of connection and disconnection with power on of the transducer

Interfaces of Main Board and Transmission Board

Signals of the main board and transmission board are defined in table below.

Table 3-11 Interfaces of main board and transmission board

CON1（J6）							
PIN	SIG	PIN	SIG	PIN	SIG	PIN	SIG
1	GND	2	GND	61	EMIT33	62	GND
3	EMIT1	4	EMIT2	63	GND	64	EMIT36
5	EMIT3	6	EMIT4	65	EMIT35	66	GND

7	GND	8	GND	67	GND	68	EMIT38
9	EMIT5	10	EMIT6	69	EMIT37	70	GND
11	EMIT7	12	EMIT8	71	GND	72	EMIT40
13	GND	14	GND	73	EMIT39	74	GND
15	EMIT9	16	EMIT10	75	GND	76	EMIT42
17	EMIT11	18	EMIT12	77	EMIT41	78	GND
19	GND	20	GND	79	GND	80	EMIT44
21	EMIT13	22	EMIT14	81	EMIT43	82	GND
23	GND	24	EMIT16	83	GND	84	EMIT46
25	EMIT15	26	GND	85	EMIT45	86	GND
27	GND	28	EMIT18	87	GND	88	EMIT48
29	EMIT17	30	GND	89	EMIT47	90	GND
31	GND	32	EMIT20	91	GND	92	EMIT50
33	EMIT19	34	GND	93	EMIT49	94	GND
35	GND	36	EMIT22	95	GND	96	EMIT52
37	EMIT21	38	GND	97	EMIT51	98	GND
39	GND	40	EMIT24	99	GND	100	EMIT54
41	EMIT23	42	GND	101	EMIT53	102	GND
43	GND	44	EMIT26	103	GND	104	EMIT56
45	EMIT25	46	GND	105	EMIT55	106	GND
47	GND	48	EMIT28	107	EMIT57	108	EMIT58
49	EMIT27	50	GND	109	GND	110	EMIT60
51	GND	52	EMIT30	111	EMIT59	112	GND
53	EMIT29	54	GND	113	EMIT61	114	EMIT62
55	GND	56	EMIT32	115	GND	116	EMIT64
57	EMIT31	58	GND	117	EMIT63	118	GND
59	GND	60	EMIT34	119	GND	120	GND

CON2（J5）							
PIN	SIG	PIN	SIG	PIN	SIG	PIN	SIG
1	PHV1_N	2	PHV1_P	31	GND	32	NC
3	PHV1_N	4	PHV1_P	33	HSSB_TX0RFCKN	34	A+75V_sub
5	NC	6	NC	35	HSSB_TX0RFCKP	36	NC
7	PHV2_N	8	PHV2_P	37	GND	38	GND
9	PHV2_N	10	PHV2_P	39	HSSB_TX0RBCKN	40	CLK_N_EMIT
11	NC	12	NC	41	HSSB_TX0RBCKP	42	CLK_P_EMIT
13	A-12V	14	A+12V	43	GND	44	GND
15	A-12V	16	A+12V	45	HSSB_TX0RN	46	HSSB_TX0TFCKN
17	A-5V1	18	A+5V1	47	HSSB_TX0RP	48	HSSB_TX0TFCKP
19	A+2V8	20	A+1V5	49	GND	50	GND
21	A+2V8	22	A+1V5	51	HSSB_TX1RN	52	HSSB_TX0TBCKN
23	RATE_P_EMIT	24	RESET_EMIT	53	HSSB_TX1RP	54	HSSB_TX0TBCKP
25	RATE_N_EMIT	26	CLOCKEN_N_EMIT	55	GND	56	GND
27	TMS	28	TDI_EMIT_TDO_BF	57	HSSB_TX0TN	58	HSSB_TX1TN
29	TDO_EMIT	30	TCK	59	HSSB_TX0TP	60	HSSB_TX1TP

Interface of Main Board and CW Board

Signals between the main board and CW board interfaces are defined as Table 3-12 and Table 3-14 .

Table 3-12 Definition of Signals of CW CON1

PIN	SIGNAL	PIN	SIGNAL
1	GND	2	GND
3	CW1	4	CW2
5	GND	6	GND
7	CW3	8	CW4
9	GND	10	GND
11	CW5	12	CW6
13	GND	14	GND
15	CW7	16	CW8
17	GND	18	GND
19	CW9	20	CW10
21	GND	22	GND
23	CW11	24	CW12
25	GND	26	GND
27	CW13	28	CW14
29	GND	30	GND
31	CW15	32	CW16
33	GND	34	GND
35	CW17	36	CW18
37	GND	38	GND
39	CW19	40	CW20

Wherein the signals of CW CON1 are defined as follows:

Table 3-13 Signals Definition of CW CON1 Socket

Signal name	Description
CW[20:1]	CW echo signal

Table 3-14 Signals Definition of CW CON2 Socket

1	A-5V1	2	A+5V1	21	TPU1_PENCIL_CW	22	AD_SDI0
3	A-5V1	4	A+5V1	23	GND	24	GND
5	GND	6	GND	25	TPU0_PENCIL_CW	26	AD_SCK0
7	BORADID_CW	8	PPID_CW	27	GND	28	GND
9	CWPPPRESENT	10	AD8333_EBL_CW	29	GND	30	AD_CNV1_CW
11	GND	12	GND	31	AD8333_4LO0_CW	32	GND
13	AD_SDO1	14	SW_CTRL1	33	AD8333_4LO1_CW	34	AD_CNV0_CW
15	AD_SDI1	16	SW_CTRL0	35	GND	36	GND
17	GND	18	GND	37	VOL_ADJ_SDA_CW	38	VOL_ADJ_SCK_CW
19	AD_SCK1	20	AD_SDO0	39	A+12V	40	A+3V6

Interfaces of Main Board and 4D Board

The interfaces between the main board and the 4D board are defined in table below.

Table 3-15 Signal Definition of main board and 4D board

PIN	Signal name	PIN	Signal name
1	12V	2	12V
3	12V	4	12V
5	12V	6	12V
7	12V	8	12V
9	GND	10	GND
11	GND	12	GND

PIN	Signal name	PIN	Signal name
13	GND	14	GND
15	GND	16	GND
17	-12V	18	-12V
19	-12V	20	-12V
21	-12V	22	-12V
23	GND	24	GND
25	GND	26	GND
27	GND	28	GND
29	VDD	30	VDD
31	GND	32	GND
33	VCC	34	VCC
35	GND	36	GND
37	NC	38	NC
39	NC	40	NC
41	NC	42	NC
43	NC	44	NC
45	NC	46	NC
47	NC	48	NC
49	GND	50	GND
51	POWEREN_N	52	GND
53	HALL	54	GND
55	NC	56	GND
57	SPI_CLK	58	GND
59	SPI_DAT	60	GND
61	SPI_SYNC	62	GND
63	FD_ID	64	GND

PIN	Signal name	PIN	Signal name
65	AD_SCLK	66	GND
67	AD_DIN	68	GND
69	AD_DOUT	70	AD_NCS

Interfaces of Main Board and Display Module

There are 3 sockets in all for the main board and display module, refer to the following 3 tables for the definitions:

Table 3-16 Definition of signals of the main board end (J25) of the LVDS socket

NO.	NAME	NO.	NAME
1	VDD	2	VDD
3	GND	4	GND
5	RXE0-	6	RXE1-
7	RXE0+	8	RXE1+
9	GND	10	GND
11	RXE2-	12	RXEC-
13	RXE2+	14	RXEC+
15	GND	16	GND
17	RXE3-	18	GND
19	RXE3+	20	GND

Table 3-17 Socket definition of display power supply (J26)

No:	Name
1	+12V
2	+12V
3	+12V
4	BL_On/Off
5	BL_ADJ
6	GND

7	GND
8	GND

Table 3-18 Definition of Color Temperature Correction Socket (J24)

PIN	Signal name
1	VDD
2	GND
3	SCL
4	SDA

Interfaces of Main Board and Speakers

The interfaces of the main board and speakers are defined in the following table:

Table 3-19 Interfaces of Main Board and Speakers (J27)

PIN	SIG
1	ROUTP
2	ROUTN
3	NC
4	LOUTP
5	LOUTN

Socket between Fan and Main Board

The interfaces of the main board and fan are defined in the following table:

Table 3-20 Socket Definition of Fan Power Supply (J29)

No.	Signal name	No.	Signal name
1	FANLF_SP	2	FANLF_PWR
3	FANLFM_CTRL	4	FANLMC_PWR
5	FANLM_SP	6	FANC_CTRL
7	FANLB_SP	8	FANC_SP
9	FANLBR_CTRL	10	FANLB_PWR
11	FANR_SP	12	FANR_PWR

FPGA JTAG Sockets of Main Board Power Management

The FPGA JTAG sockets of the main board are defined in the following table:

Table 3-21 Signal Definition of FPGA JTAG sockets (J23) of Power Management

No.	Signal name
1	VPUMP
2	VJTAG
3	GND
4	TDO
5	TDI
6	TCK
7	TMS
8	TRST

Reserved Signal Interfaces

The reserved signal interfaces are defined in the following table:

Table 3-22 Definition of Reserved Signal Interfaces (J17)

No.	Signal name	No.	Signal name
1	NC	2	GND
3	NC	4	GND
5	GND	6	GND
7	NC	8	ATA_ACT#
9	SYS_RESET#	10	GND
11	CPRT_PRINT	12	BK_STS
13	CPRT_BUSY	14	GND
15	GND	16	SVIDEO_Y2
17	PWR_SSW	18	SVIDEO_C2
19	GND	20	GND

Reserved Power Interfaces;

The reserved power interfaces are defined in the following table:

Table 3-23 Definition of Reserved Power Interfaces (J20)

No.	Name	No.	Name
1	+12V	2	+12V
3	+12V	4	+12V
5	Gnd	6	Gnd
7	Gnd	8	Gnd
9	Gnd	10	Gnd
11	+5V	12	+5V
13	+5V	14	+5V
15	+5V	16	+5V
17	+5V	18	+5V
19	Gnd	20	Gnd
21	Gnd	22	Gnd
23	+3.3V	24	+3.3V

The Interface between the Main Board and Adapter

The interfaces between the main board and the adapter are defined as follows:

Table 3-24 Interface (J21) of Main Board and Speakers

No.	Name	Direction
1	Gnd	\
6	Gnd	\
2	Gnd	\
4	Gnd	\
3	+12V	In
7	+12V	In

No.	Name	Direction
5	+12V	In
8	+12V	In

The Interface between the Main Board and Power Module

The interfaces between the main board and the power module consist of digital socket and analog power socket.

The digital socket is defined in the following table:

Table 3-25 Socket Definition of igital Socket (J22)

No.	Signal name	No.	Signal name
1	EDC_PWR	2	EDC_PWR
3	EDC_PWR	4	EDC_PWR
5	EDC_PWR	6	EDC_PWR
7	EDC_GND	8	EDC_GND
9	EDC_GND	10	EDC_GND
11	EDC_GND		EDC_GND
13	-12V	14	STS_EDC#
15	GND	16	GND
17	POWER_ON#	18	CPU12V_OK#
19	T_D+	20	T_D-
21	GND	22	GND
23	GND	24	GND
25	12V+	26	12V+
27	12V+	28	12V+
29	GND	30	GND
31	5V+	32	5V+
33	GND	34	GND
35	5VSTB_OK#	36	5VSTB_EN#

No.	Signal name	No.	Signal name
37	GND	38	GND
39	5VSTB_CPU	40	3V3STB
41	GND	42	GND
43	3V3	44	3V3
45	GND	46	GND
47	2V8	48	1V5
49	GND	50	GND
51	1V8	52	1V8
53	GND	54	GND
55	PWR_RX	56	PWR_CONF_N
57	PWR_TX	58	PWR_RST
59	GND	60	GND
61	PRT_BATA	62	PRT_BATB
63	BATSTS_O	64	BATSTS_G

Table 3-26 Signal Definition of Socket (J9) between Analog Power and Main Board

No.	Signal name	No.	Signal name
1	GND	2	GND
3	A5V1	4	A5V1
5	A5V1	6	A5V1
7	GND	8	GND
9	-A5V1	10	GND
11	-A12V	12	GND
13	GND	14	GND
15	A1V5	16	A1V5
17	A1V5	18	A1V5
19	GND	20	GND

No.	Signal name	No.	Signal name
21	A3V6	22	A3V6
23	GND	24	GND
25	A2V8	26	GND
27	A12V	28	GND
29	PHV1+	30	PHV2+
31	GND	32	GND
33	PHV1-	34	PHV2-
35	GND	36	GND
37	85V+	38	GND
39	GND	40	85V-

Interfaces of Main Board and I/O Extend Board

Signal definition between master board and I/O extended board is shown as table below.

Table 3-27 Signal Definition between Mater Board and I/O Extended Socket-J1

PIN	Definition of Signal	PIN	Definition of Signal	PIN	Definition of Signal	PIN	Definition of Signal
A1	USB+4	B1	USB-4	C1	USB+5	D1	USB-5
A2	VBUS_SYS45	B2	GND	C2	VBUS_SYS45	D2	GND
A3	GND	B3	VGA_HS	C3	VGA_RED	D3	VGA_GREEN
A4	UART_RX0	B4	VGA_VS	C4	GND	D4	SDISP_PRT_N
A5	UART_TX0	B5	GND	C5	VGA_BLUE	D5	
A6	GND	B6	AUDIO_L	C6	GND	D6	
A7	BWPRT _PRINT	B7	AUDIO_R	C7		D7	GND
A8	BWPRT_BUSY	B8	GND	C8	DVI_D0+	D8	DVI_D0-
A9	GND	B9	ECG_PWR	C9	DVI_D1+	D9	DVI_D1-
A10	MIC_L	B10	DVI_HPD	C10	GND	D10	GND
A11	MIC_R	B11		C11	DVI_CLK+	D11	DVI_CLK-

PIN	Definition of Signal	PIN	Definition of Signal	PIN	Definition of Signal	PIN	Definition of Signal
A12	VIDEO	B12	ECG_TX	C12	DVI_D2+	D12	DVI_D2-
\	\	B13	ECG_RX	\	\	D13	ECG_PRT

The Interfaces between the Main Board and the Keyboard

The interfaces between the main board and the keyboard are defined in table below.

Table 3-28 Signal Definition between Master Board and Keyboard Board-J19

No.	Name	No.	Name
1	+3.3V	2	+3.3V
3	+3.3V	4	+3.3V
5	Gnd	6	Gnd
7	Gnd	8	Gnd
9	+5V	10	+5V
11	+5V	12	+5V
13	Gnd	14	Gnd
15	Gnd	16	Audio Out
17	Gnd	18	Gnd
19	Work_Status_O	20	Work_Status_G
21	Battery_Status_O	22	Battery_Status_G
23	Gnd	24	EDC_Status_G
25	USB_DN	26	LCD_SW
27	USB_DP	28	Power_BTN
29	Gnd	30	Gnd

3.2.2.9 Testing Points of Main Board and LED Indicator Light

The testing points of the main board are shown in the following figures:

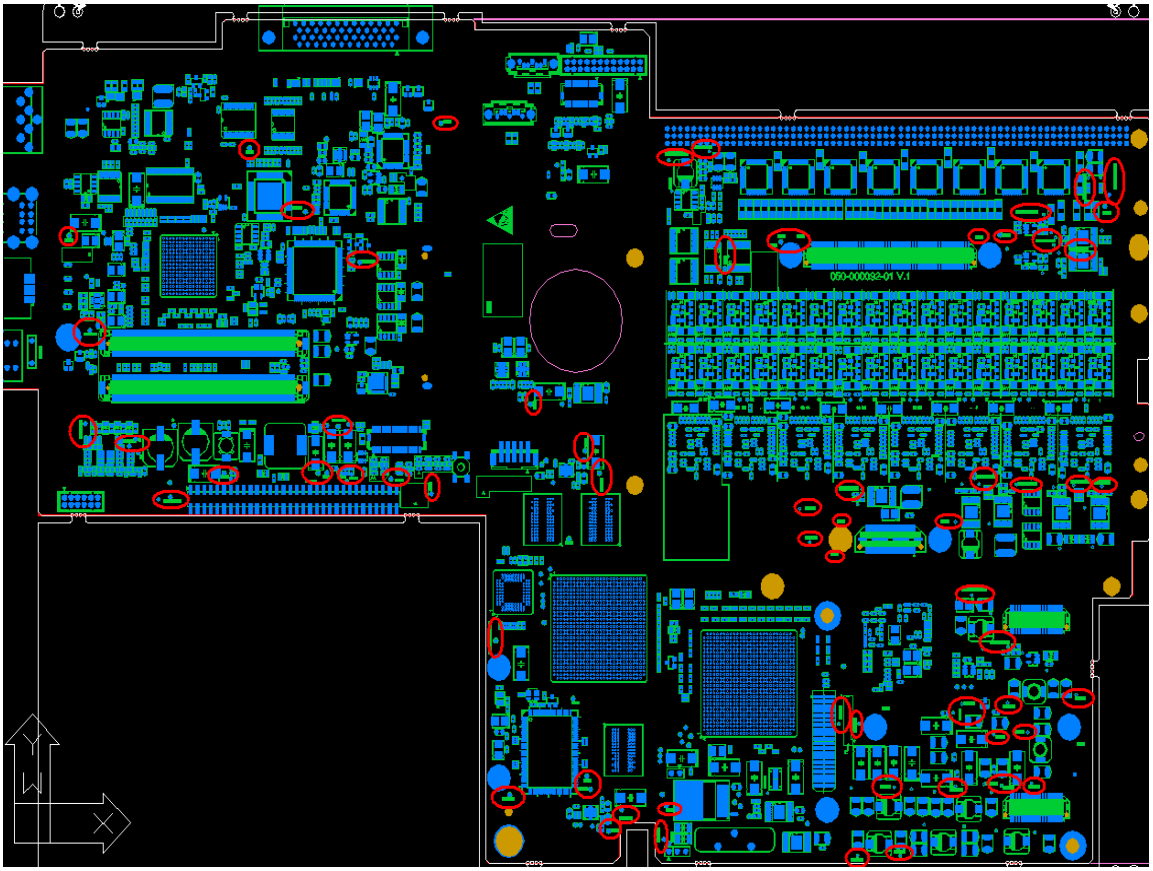


Fig 3-12 Testing Points of Main Board

Table 3-29 List of Testing Points of Main Board

No.	Label of the Testing Point	Network of the Testing Point
1	TP206-GND	Ground network
2	TP248-VAA0	Voltage of video DA chip (3.3V)
3	TP228-1V5STB	Power management standby voltage (1.5V)
4	TP249-SV-VDD	Voltage of video driving chip (3.3V)
5	TP202-12V	12V voltage (12V)
6	TP246-3V3S_CPU	PC module standby (3.3V)
7	TP7-PWROK	Power OK signal of PC module (3.3V)
8	TP9-S3	Initialization status indicating signal S3 of PC module (3.3V)
9	TP8-S4	Initialization status indicating signal S4 of PC module (3.3V)

No.	Label of the Testing Point	Network of the Testing Point
10	TP10-S5	Initialization status indicating signal S5 of PC module (3.3V)
11	TP224-EDC_PWR	12V input of the adapter (12V)
12	TP218-N12V	-12V voltage (-12V)
13	TP215-5VSBY	Standby voltage (5V)
14	TP203-VDD	VDD voltage (3.3V)
15	TP217-D1V5	D1V5 voltage (1.6V)
16	TP216-D2V8	D2V8 voltage (3.0V)
17	TP6-CPUBTN	Button start-up signal of PC module (3.3V)
18	TP214-D1V8	D1V8 voltage (1.8V)
19	TP201-VCC	VCC voltage (5V)
20	TP20-IQ_VTT	VTT voltage of DDR2 (0.9V)
21	TP236-VCCINT_DSP_MF	FPGA core voltage (1.2V)
22	TP226-12V_4D	12V voltage of 4D module (12V)
23	TP235-D2V5	D2V5 voltage (2.5V)
24	TP19-UP_VTT	VTT voltage of DDR2 (0.9V)
25	TP227-3V3STB	Standby voltage (3.3V)
26	TP146-A+5V_PROBE	Transducer port 5V
27	TP148-A+3V3_PRB	Transducer port 3.3V
28	TP147-A+5V1	Analog 5V
29	TP155-A-5V_HVISO2	High-voltage isolation power
30	TP241-A-85V_HVSW	High-voltage switch power
31	TP151-A+85V_HVSW	High-voltage switch power
32	TP153-A+5V_HVISO2	High-voltage isolation power
33	TP152-A+5V_HVISO1	High-voltage isolation power
34	TP193-A-12V	-12V power
35	TP165-A+1V8_ADS	AFE power

No.	Label of the Testing Point	Network of the Testing Point
36	TP194--12V_A	-12V power
37	TP163-A+3V3_VCA	AFE power
38	TP164-A+3V3_ADS	AFE power
39	TP178-A+5V_ATGC	ATGC power
40	TP162-A+5V_VCA	AFE power
41	TP144-A+3V3_CLOCK	Clock power
42	TP240-VBAT	Voltage of the button cell (3V)
43	TP190-A+1V5	Analog 1.5V power
44	TP189-＋1V5_A	Analog 1.5V power
45	TP184-＋5V1_A	Analog 5V power
46	TP137-A+5V1	Analog 5V power
47	TP196-+12V_A	Analog 12V power
48	TP195-A+12V	Analog 12V power
49	TP187-+2V8_A	Analog 2.8V power
50	TP185-+3V6_A	Analog 3.6V power
51	TP186-A+3V6	Analog 3.6V power
52	TP180--95V_A	Analog -95V power
53	TP188-A+2V8	Analog 2.8V power
54	TP192--5V1_A	Analog -5V power
55	TP36-+95V_A	Analog 95V power
56	TP191-A-5V1	Analog -5V power
57	TP38-A-95V	Analog -95V power
58	TP179-A-5V_ATGC	ATGC-5V power
59	TP37-A+95V	Analog 95V power

Table 3-30 Main board LED indicator light

No.	LED	Indication
1	D227	12V
2	D18	VCC
3	D17	VDD
4	D220	Multifunctional FPGA configuration indicator light
5	D11	DSP FPGA configuration indicator light
6	D15	Beam FPGA configuration indicator light

3.2.3 Principle of Transmitting Board

The main board sends commands to transmitting board, the transmitting board calculates the parameters in real time and controls the high-voltage pulses necessary for the output of the transmitting circuit. The schematic diagram is shown below:

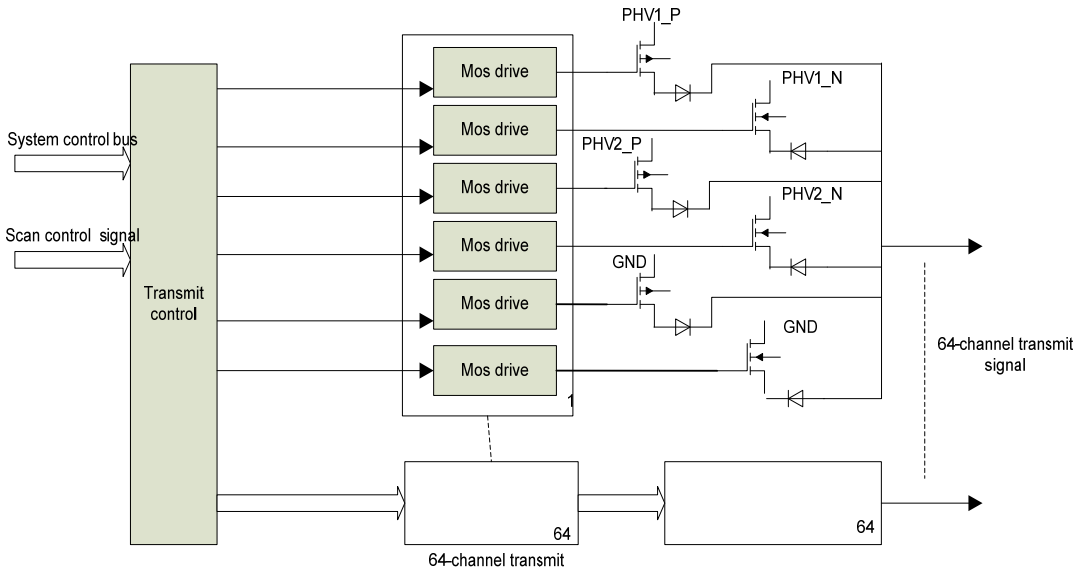


Fig 3-13 Structure Diagram of Ultrasound Transmission

3.2.3.1 Power Structure of Transmission Board

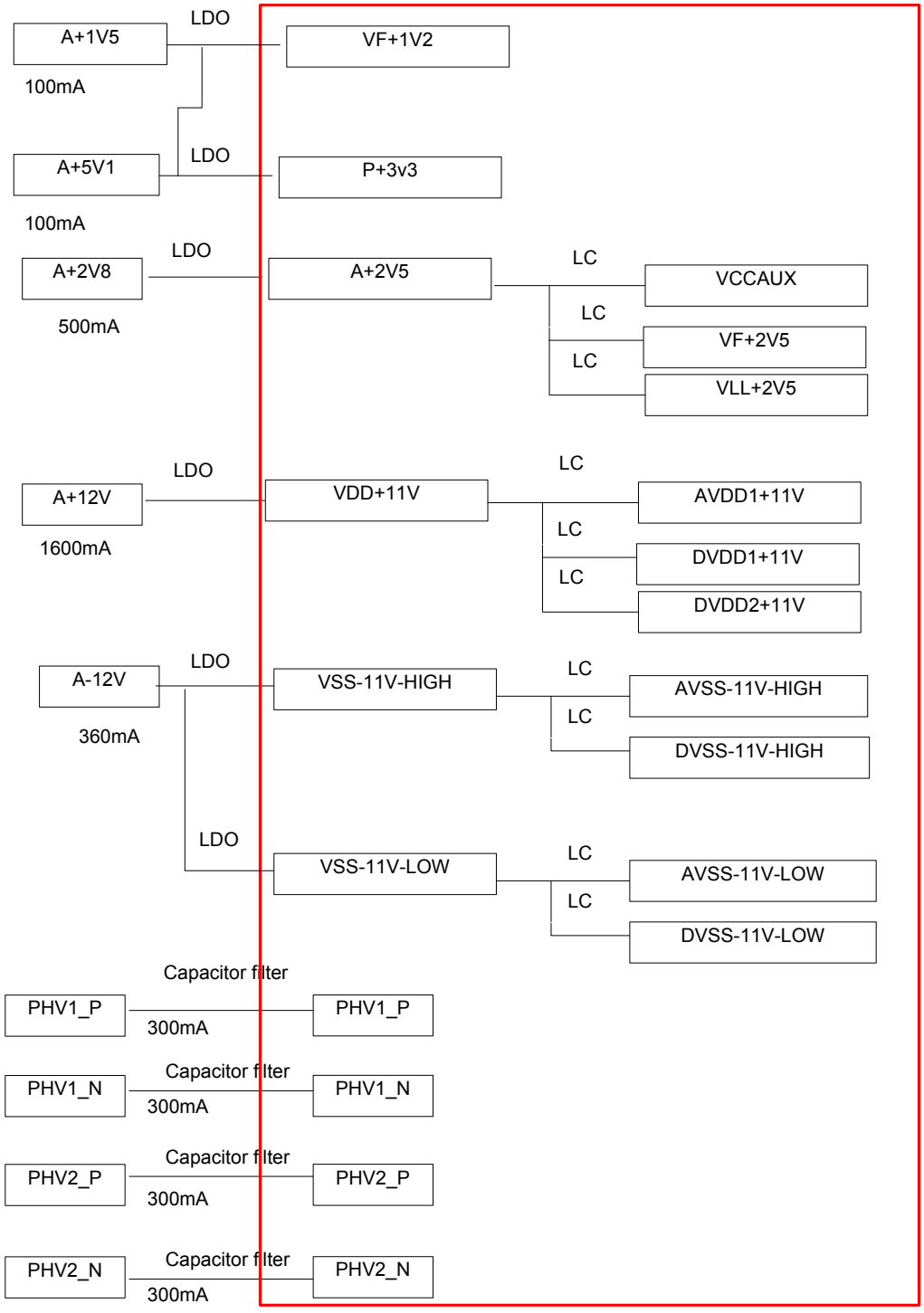


Fig 3-14 Structure Diagram of Transmitting Board Power Supply

3.2.3.2 Definition of Transmission Board Interface

Detailed definition of external interface of transmission board is shown below:

Table 3-31 Detailed Definition of External Interface of Transmission Board

Interface with the Main Board	（DSP_FPGA）HSSB_TX0TP/N，HSSB_TX1TP/N，HSSB_TX0TBCKP/N，HSSB_TX0TFCKP/N,HSSB_TX0RP/N，HSSB_TX1RP/N, HSSB_TX0RBCKP/，HSSB_TX0RFCKP/NCLOCKEN_N_EMIT
	(BF_FPGA) RESET_EMIT，RATE_P/N_EMIT
	(clock) CLK_P/N_EMIT
Interface with analog part of main board	64-channel transmission pulse/echo POUT[EMIT64..1]
Interface with power of main board	A+12V,A-12V,A+5V1,A-5V1,A+2V8，A+1V5,PHV1_P,PHV1_N,PHV2_P,PHV2_N
JTAG signal	TCK，TDO_EMIT，TMS，TDI_EMIT_TDO_BF

The instrumentation diagram of transmission board is shown in the following figure. The figure marks the sockets and their names.

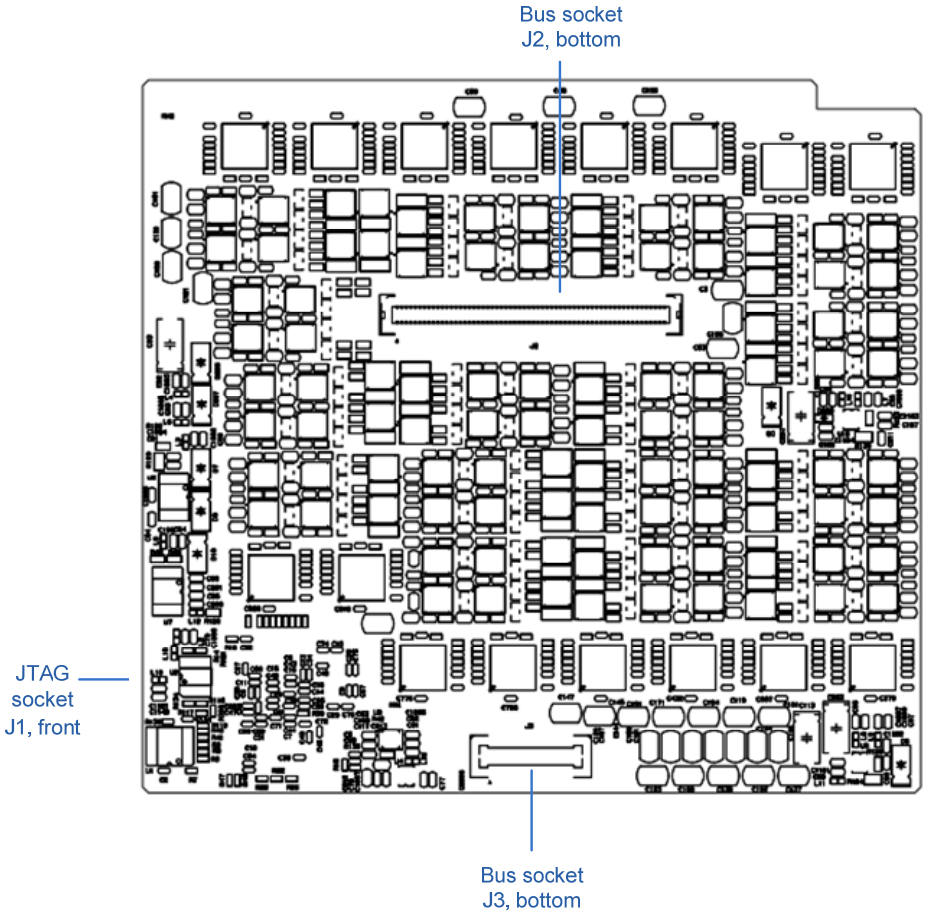


Fig 3-15 The instrumentation diagram of transmission board

Table 3-32 Definition of J1 of JTAG Socket

1	JTAG_TCK
2	JTAG_ TDO_EMIT
3	JTAG_ TMS
4	JTAG_ TDI_EMIT_TDO_BF
5	P+3V3
6	GND
7	NC
8	NC

Table 3-33 Detailed Definition of Bus Socket J2

1	GND	2	GND	61	EMIT33	62	GND
3	EMIT1	4	EMIT2	63	GND	64	EMIT36
5	EMIT3	6	EMIT4	65	EMIT35	66	GND
7	GND	8	GND	67	GND	68	EMIT38
9	EMIT5	10	EMIT6	69	EMIT37	70	GND
11	EMIT7	12	EMIT8	71	GND	72	EMIT40
13	GND	14	GND	73	EMIT39	74	GND
15	EMIT9	16	EMIT10	75	GND	76	EMIT42
17	EMIT11	18	EMIT12	77	EMIT41	78	GND
19	GND	20	GND	79	GND	80	EMIT44
21	EMIT13	22	EMIT14	81	EMIT43	82	GND
23	GND	24	EMIT16	83	GND	84	EMIT46
25	EMIT15	26	GND	85	EMIT45	86	GND
27	GND	28	EMIT18	87	GND	88	EMIT48
29	EMIT17	30	GND	89	EMIT47	90	GND
31	GND	32	EMIT20	91	GND	92	EMIT50

33	EMIT19	34	GND	93	EMIT49	94	GND
35	GND	36	EMIT22	95	GND	96	EMIT52
37	EMIT21	38	GND	97	EMIT51	98	GND
39	GND	40	EMIT24	99	GND	100	EMIT54
41	EMIT23	42	GND	101	EMIT53	102	GND
43	GND	44	EMIT26	103	GND	104	EMIT56
45	EMIT25	46	GND	105	EMIT55	106	GND
47	GND	48	EMIT28	107	EMIT57	108	EMIT58
49	EMIT27	50	GND	109	GND	110	EMIT60
51	GND	52	EMIT30	111	EMIT59	112	GND
53	EMIT29	54	GND	113	EMIT61	114	EMIT62
55	GND	56	EMIT32	115	GND	116	EMIT64
57	EMIT31	58	GND	117	EMIT63	118	GND
59	GND	60	EMIT34	119	GND	120	GND

Table 3-34 Detailed Definition of Bus Socket J3

1	PHV1_N	2	PHV1_P	31	GND	32	NC
3	PHV1_N	4	PHV1_P	33	HSSB_TX0RFCKN	34	A+75V_sub
5	NC	6	NC	35	HSSB_TX0RFCKP	36	NC
7	PHV2_N	8	PHV2_P	37	GND	38	GND
9	PHV2_N	10	PHV2_P	39	HSSB_TX0RBCKN	40	CLK_N_EMIT
11	NC	12	NC	41	HSSB_TX0RBCKP	42	CLK_P_EMIT
13	A-12V	14	A+12V	43	GND	44	GND
15	A-12V	16	A+12V	45	HSSB_TX0RN	46	HSSB_TX0TFCKN

17	A-5V1	18	A+5V1	47	HSSB_TX0RP	48	HSSB_TX0TFCKP
19	A+2V8	20	A+1V5	49	GND	50	GND
21	A+2V8	22	A+1V5	51	HSSB_TX1RN	52	HSSB_TX0TBCKN
23	RATE_P_EMIT	24	RESET_EMIT	53	HSSB_TX1RP	54	HSSB_TX0TBCKP
25	RATE_N_EMIT	26	CLOCKEN_N_EMIT	55	GND	56	GND
27	TMS	28	TDI_EMIT_TDO_BF	57	HSSB_TX0TN	58	HSSB_TX1TN
29	TDO_EMIT	30	TCK	59	HSSB_TX0TP	60	HSSB_TX1TP

3.2.4 4D Driving Board

The principle diagram of 4D driving board is shown in figure below. The interface signals of 4D driving board and main board consist of power, SPI interface signals of ADC and DAC, and the enabling signal of power module. The interface signals of 4D driving board and transducer connecting board are: two driving signals A and B, HALL signal and its 5V power supply, and temperature and angle signals of TEE transducer. 4D driving board mainly implements the following two functions:

- Amplifies the command-driven current and generates signals of appropriate power to drive the transducer to the desired position.
- As a reserved design, it amplifies the temperature and angle signals of the TEE transducer and provides data collection channel.

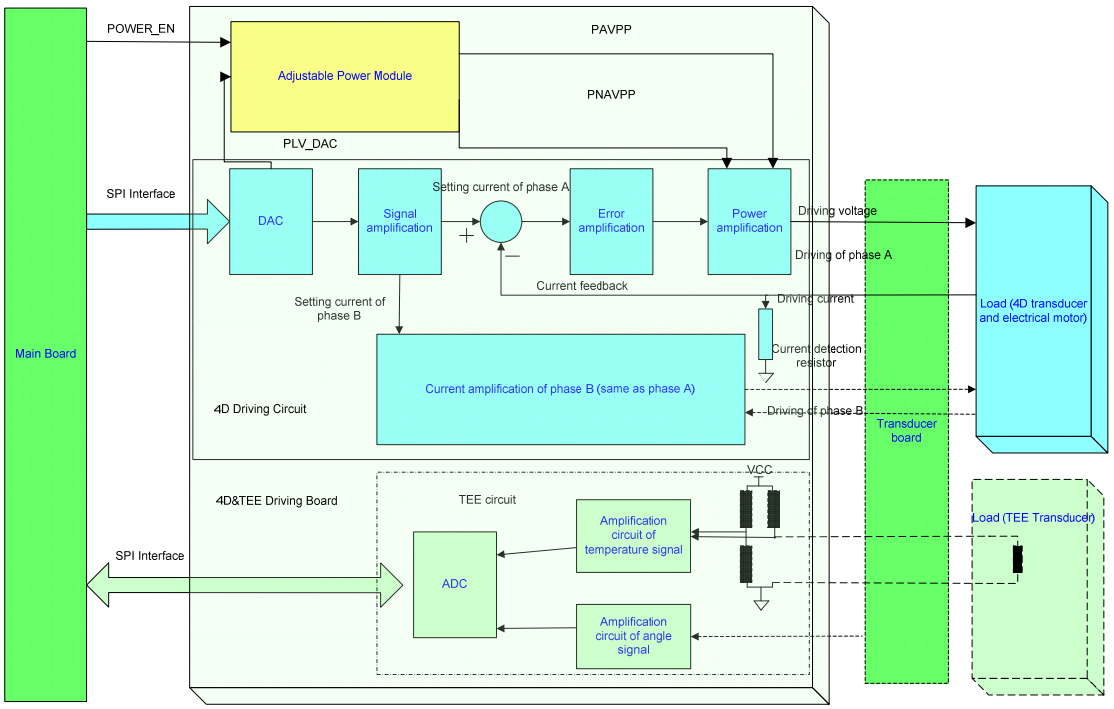


Fig 3-16 Block diagram of 4D driving board

3.2.4.1 Definition of the Interface between the 4D Driving Board and Main Board

Signals of the socket are defined as follows:

Table 3-35 Definition of Socket between 4D Driving Board and Main Board

PIN	Signal name	Direction	PIN	Signal name	Direction
1	12V	Input	2	12V	Input
3	12V	Input	4	12V	Input
5	12V	Input	6	12V	Input
7	12V	Input	8	12V	Input
9	GND	/	10	GND	/
11	GND	/	12	GND	/
13	GND	/	14	GND	/
15	GND	/	16	GND	/
17	-12V	Input	18	-12V	Input

PIN	Signal name	Direction	PIN	Signal name	Direction
19	-12V	Input	20	-12V	Input
21	-12V	Input	22	-12V	Input
23	GND	/	24	GND	/
25	GND	/	26	GND	/
27	GND	/	28	GND	/
29	VDD	Input	30	VDD	Input
31	GND	/	32	GND	/
33	VCC	Input	34	VCC	Input
35	GND	/	36	GND	/
37	NC	/	38	NC	/
39	NC	/	40	NC	/
41	NC	/	42	NC	/
43	NC	/	44	NC	/
45	NC	/	46	NC	/
47	NC	/	48	NC	/
49	GND	/	50	GND	/
51	PWR_EN	Input	52	GND	/
53	HALL	Output	54	GND	/
55	NC	/	56	GND	/
57	SPI_CLK	Input	58	GND	/
59	SPI_DAT	Bidirectional	60	GND	/
61	SPI_SYNC	Input	62	GND	/
63	FD_ID	Bidirectional	64	GND	/
65	AD_SCLK	Input	66	GND	/
67	AD_DIN	Input	68	GND	/
69	AD_DOUT	Output	70	AD_NCS	Input

Note: wherein the direction of signal is defined as: the signal from main board to 4D driving board is input signal, the signal from 4D driving board to main board is output signal.

3.2.4.2 Definition of the Interface between the 4D Driving Board and Transducer Connecting Board

The wire-to-board socket (WTB) of 4D driving board signals are defined as follows:

Table 3-36 Definition of Socket between 4D Driving Board and Transducer Connecting Board

PIN	Signal name	Direction
1	AGND	/
2	5V	Output
3	HALL	Input
4	ANGLE	Input
5	AGND	/
6	T+	Input
7	T-	Input
8	PHASE_B_NEG	Output
9	PHASE_B_NEG	Output
10	PHASE_B_POS	Output
11	PHASE_B_POS	Output
12	PHASE_A_NEG	Output
13	PHASE_A_NEG	Output
14	PHASE_A_POS	Output
15	PHASE_A_POS	Output

Note: wherein the direction of signal is defined as: the signal from transducer connecting board to 4D driving board is input signal, the signal from 4D driving board to transducer connecting board is output signal.

3.2.4.3 Testing Points of 4D Driving Board

The testing points of 4D driving board are listed in the following table:

Table 3-37 List of Testing Points of 4D Driving Board

No.	Label of the Testing Point	Signal definition of testing points
1	TP3	Command current bias voltage from DAC (DAC_BIAS)
2	TP4	Output of command current error amplification circuit of phase B
3	TP5	Positive output of driving current of phase B (PHASE_B_POS)
4	TP6	Command current of phase B from DAC (DAC_B_SET)
5	TP7	Output of command current signal amplification circuit of phase B
6	TP8	Command current of phase A from DAC (DAC_A_SET)
7	TP9	Output of command current signal amplification circuit of phase A
8	TP10	Output of command current error amplification circuit of phase A
9	TP11	Positive output of driving current of phase A (PHASE_A_POS)

3.2.5 Principle of Keyboard Board

3.2.5.1 General Description

The control panel of 2118 implements the following functions:

Input from buttons: input by general button, combination button, repeat button and encoder are supported;

Backlight LED of buttons, control of status indicating LEDs

Control of beeps of buttons; larger adjustable range of volume; more than 3 grades are provided;

TGC input, full-scale and 0 available

Input from encoder

Input from optical trackball; control of backlight of optical trackball

3.2.5.2 Block Diagram of Structure

The block diagram of control panel is shown in below:

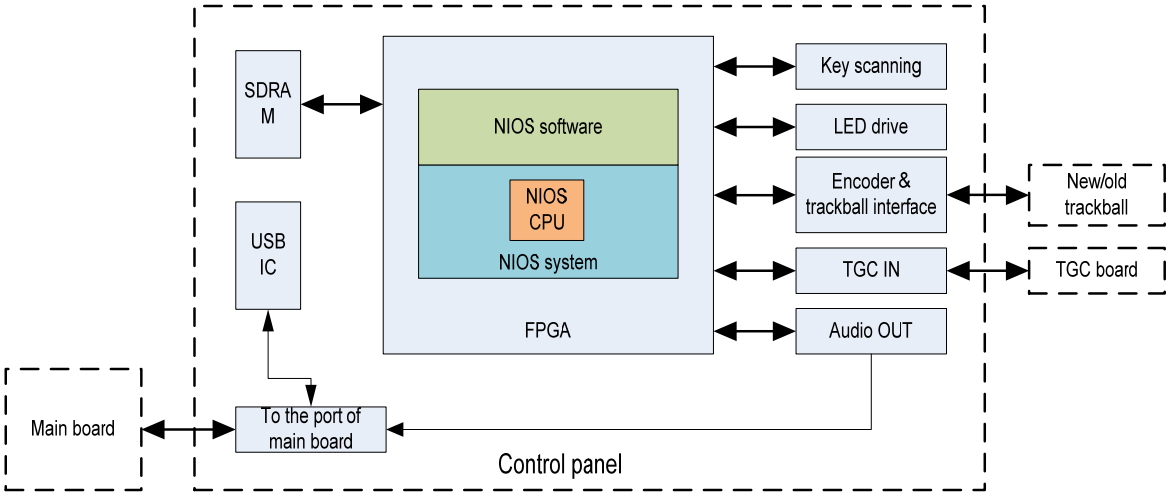


Fig 3-17 Block Diagram of the Control Panel

3.2.5.3 Scanning Circuit of Buttons

The keyboard array is controlled by row-and-column controlling method. FPGA outputs tests signals line-by-line. When a key is pressed, the corresponding row and line signals shall be consistent. According to the numbers of the row and line, the position of the key pressed can be defined.

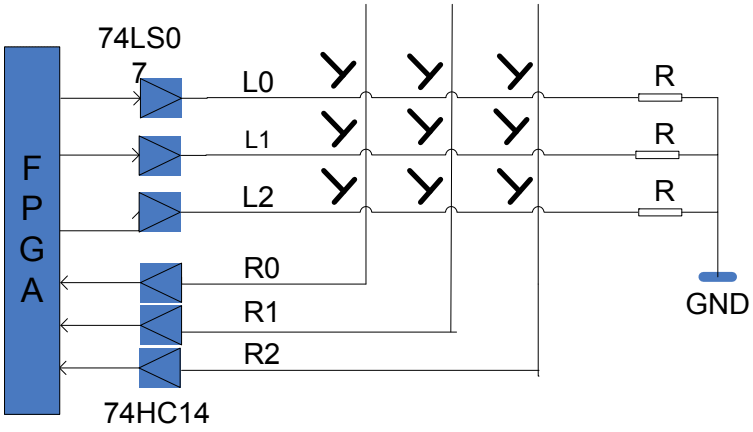


Fig 3-18 Principle Diagram of Key Scanning

3.2.5.4 Driving of LED

Constant-current source driving dedicated chip is adopted to drive the LEDs.

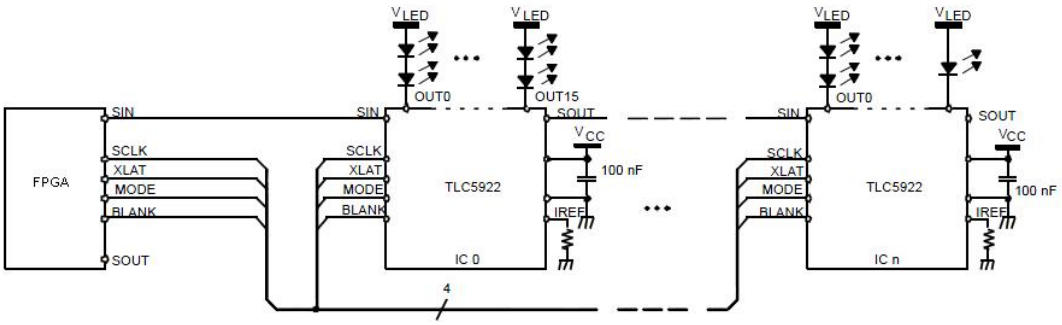


Fig 3-19 Connection of LED Driving Circuit

There are 16 constant-current sources for each TLC5922, and the brightness can be adjusted respectively.SPI interface control is adopted for TLC5922, and plural chips can be connected in series for control. The power supply voltage is 5V.

3.2.5.5 Processing of Signals from Trackball

A newly designed optical trackball and a mechanical trackball are supported by 2118. The advantages of the new trackball are:

- Higher resolution and performance;
- Full color backlight;
- Optical device, no need for daily clean;
- Larger in size;
- Digital interface, more flexible in control;

The data returned from the trackball interface is square waveform data. There are a pair of signal cables in X and Y directions respectively, and four signal cables in all. The trackball is powered by 5V, supplied by the control panel.

The basic scheme of the optical trackball is shown below. It consists of trackball IC and backlight LED.

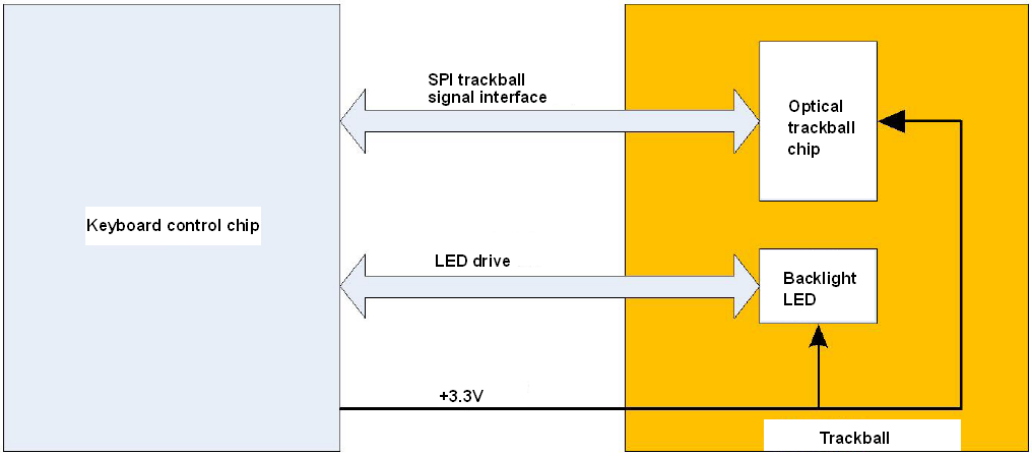


Fig 3-20 Basic Scheme of the Optical Trackball

3.2.5.6 Buzzer

The speaker is piezoelectric ceramic. It is driven by 74LS07. The basic drive circuit is shown below:

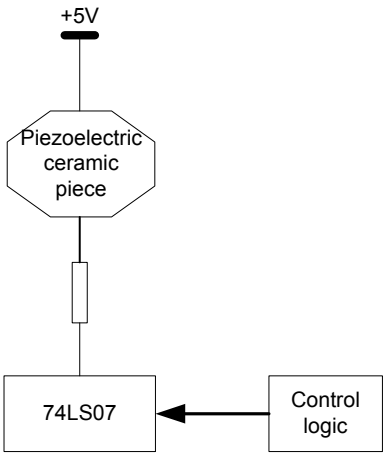


Fig 3-21 Speaker Control Circuit

The piezoelectric ceramic has no positive / negative pole. As long as driving voltage with appropriate frequency is put to its two ends, it will make a sound with the same frequency as that of the driving voltage.

Whether it sounds or not, this is under the control of control logic. To generate sounds of different frequencies, just change the frequency of the driving circuit.

3.2.5.7 Encoder Circuit

There are two encoders on the control panel, and each encoder has two signal cables. The output signal is in the form of square waveform and the electrical level is 5V.

3.2.5.8 TGC Interface Circuit

TGC is actually a group of sliding rheostats, the output voltage of which is in linear relationship with its slider displacement. The output analog voltage is converted to digital signal by AD converter and sent to FPGA, thus obtaining the slider position.AD is powered by 3.3V, externally connected to 2.5V reference level. To keep good precision of the AD converter, the output of the sliding potentiometer is applied with LM358 for follow-up. The principle of the interface is shown in figure below.

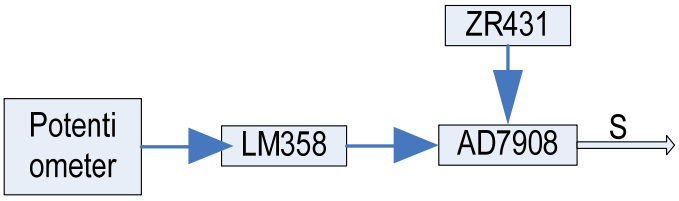


Fig 3-22 TGC Interface Circuit

3.2.5.9 FPGA and Peripheral Circuits

FPGA is the core of boards and cards, externally connected to SPI flash and SDRAM. Its logic and software codes are stored in SPI Flash, and they are loaded to FPGA and initiate the software when powered on.

NiosII soft core is a 32bit CPU. It can read and write SPI Flash on line and support on-line code upgrading.

FPGA, Flash and SDRAM are all 3.3V devices. The core voltage of FPGA is 1.2V.

3.2.5.10 USB Communication Interfaces

FPGA is externally connected with a USB interface chip U4 (3.3V device), supporting USB communication protocol 1.1. The frequency of external crystal oscillator X1 is 6MHz.USB interface is shown in figure below. In the figure, L8 is common mode suppression inductor, and U5 is anti-static chip.

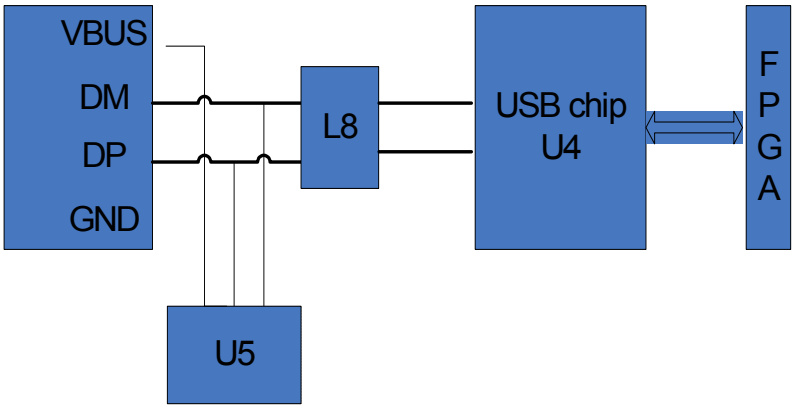


Fig 3-23 Schematic of USB Port

3.2.5.11 Socket Definition

The components and sockets positions of the control panel are shown in the following figures. The socket definition is shown in Table 3-38.

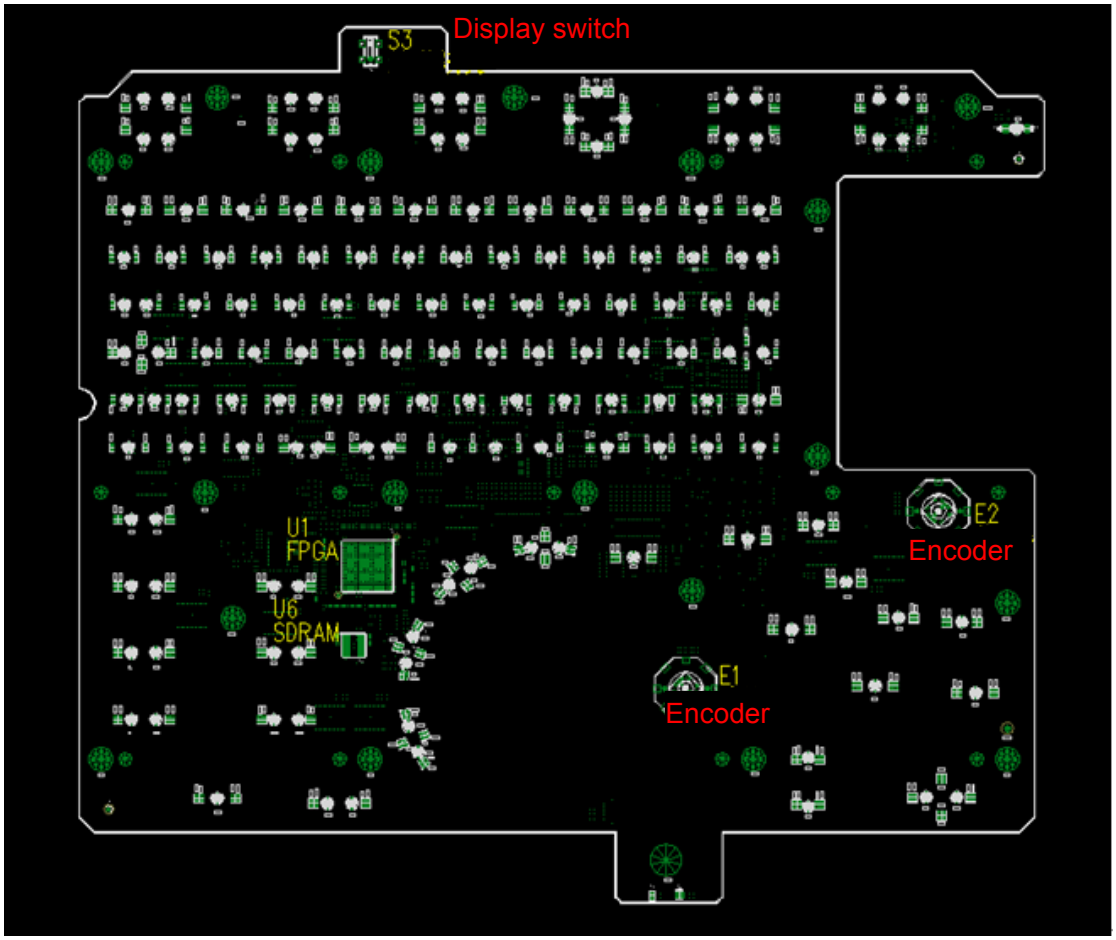


Fig 3-24 Components Layout of the Control Panel Board (Frontal)

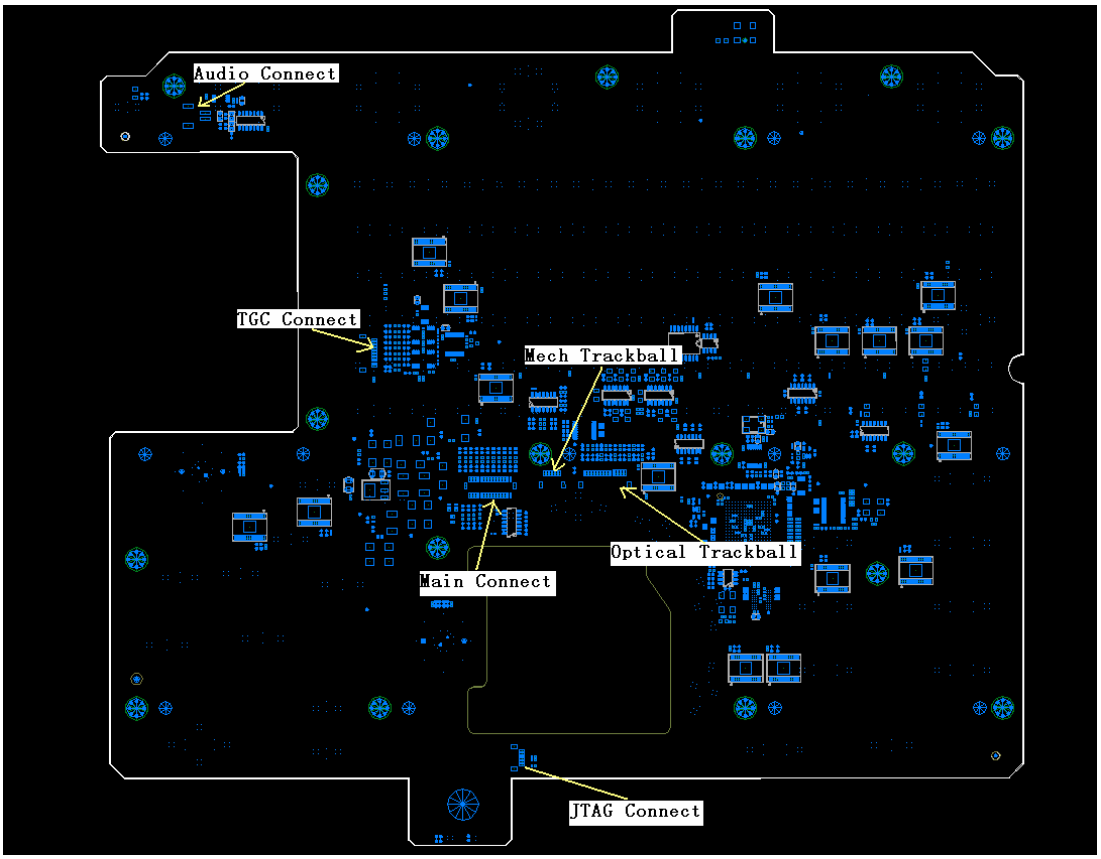


Fig 3-25 Components Layout of the Control Panel Board (Bottom)

Table 3-38 Definition Table of Keyboard Board Socket

Socket number on PCB	Name	Definition of Pin			Notes
		Pin No	Definition of Pin	Description of PIN	
J1	JTAG debugging socket	1	TCK	TCK signal, pull-down	
		2	TDO	TDO	
		3	TMS	TMS signal, pull up 3.3V	
		4	TDI	TDI signal, pull up 3.3V	
		5	VDD	3.3V power	
		6	GND	System ground	
J2	TGC socket	1	TGC VDD	3.3V power	

		2	GND	System ground	
		3	ATGC0	Slide bar 0 output	
		4	ATGC1	Slide bar 1 output	
		5	ATGC2	Slide bar 2 output	
		6	ATGC3	Slide bar 3 output	
		7	ATGC4	Slide bar 4 output	
		8	ATGC5	Slide bar 5 output	
		9	ATGC6	Slide bar 6 output	
		10	ATGC7	Slide bar 7 output	
J3	Main board connecting socket	3	DP	USB-DP	
		4	POWER_STB	Power status	Power connecting switch K93
		5	DN	USB-DN	
		6	LCD_SW	Display position status	Connect display position switch S3
		8	EDC_STATUS_G	EDC status	Connection indicator light D4
		9	BATTERY_STATUS_O	Power status O	Connection indicator light D5
		10	BATTERY_STATUS_G	Power status G	Connection indicator light D5
		11	WORK_STATUS_O	Working status O	Connection indicator light D6-7

		12	WORK_STATUS_G	Working status G	Connection indicator light D6-7
		1,2,7,13~15,17~18，23~26	GND	System ground	
		16	Audio Out	Keyboard board audio power amplification output	Reserved
		19~22	+5	External input 5V	
		27~30	+3V3	External input 3.3V	
J5	Mechanical trackball socket	1	GND	System ground	
		2	VCC	5V	
		3	TRACK_HBALL2	Trackball signal 2	Signal 0 and 1 is a match; signal 2 and 3 is a match
		4	TRACK_HBALL3	Trackball signal 3	
		5	TRACK_HBALL0	Trackball signal 0	
		6	TRACK_HBALL1	Trackball signal 1	
J4	Mechanical trackball socket	1，9，11，13，15	GND	System ground	
		2	VDD		
		3	MISO	Serial Data Output (Master In/Slave Out)	Output
		4	MOSI	Serial Data Input(Master Out/Slave In)	Input

		5	SCLK	Serial Clock Input	Input
		6	NCS	Chip Select(Active Low Input)	Input
		7	MOTION	Motion Detect （Active Low Output）	Input
		8	SHTDWN	Shutdown（Active High Input）	Input
		10	LED_DRIVER 1	LED driver 1	Input
		12	LED_DRIVER 2	LED driver 2	Input
		14	LED_DRIVER 3	LED driver 3	Input
J8	Buzzer socket	1	BUZ0	Buzzer signal 0	
		2	BUZ1	Buzzer signal 1	

3.2.6 Display Unit

The LCD interface consists of LVDS digital signal input interface and CCFL strip lamps interface; wherein LVDS signals are low-voltage difference digital signals, and VDD is 3.3V; the definition of its socket connecting to main board is shown as follows:

Table 3-39 Interfaces of Main Board and Speakers

PIN	Definition	PIN	Definition
1	VDD	2	VDD
3	GND	4	GND
5	RXE0-	6	RXE1-
7	RXE0+	8	RXE1+
9	GND	10	GND
11	RXE2-	12	RXEC-

PIN	Definition	PIN	Definition
13	RXE2+	14	RXEC+
15	GND	16	GND
17	RXE3-	18	GND

CCFL strip lamps are supplied with high voltage from the inverter, producing different brightness according to different currents. The principle of the inverter is:

The 12V input of the inverter comes from the main board. The main IC of the inverter drives 4 MOSFETs opening/closing alternatively and puts AC square wave to the primary winding the transformer. The high-voltage square wave induced by the secondary winding is transformed into sine wave through LC filtering and drives CCFL strip lamp shining. The switch signal controls the on/off of the strip lamp by controlling the enabling of main IC. The brightness signal adjusts the brightness of the strip lamp by controlling the duty cycle of square wave of main IC.

The inverter board is equipped with protection circuits of strip lamp open circuit, overvoltage and over-current. Protection of strip lamp: whenever any of the strip lamps is open circuit, the protection circuit will act; over-current protection: when the output current is over-current, the feedback signals from the strip lamp to main IC will restrain the duty ratio of the square wave to reduce the current for protection; overvoltage protection: the IC has been configured with the voltage-limiting function to ensure the output voltage is not too high. The socket J26 connecting to main board is defined as follows:

Table 3-40 Interfaces of Main Board and Inverter

PIN	Definition
1	12V
2	12V
3	12V
4	ON/OFF
5	ADJ
6	GND
7	GND
8	GND

Wherein ON/OFF is the switch signal of the inverter; ADJ controls the brightness of the LCD by inputting different voltages which are then converted to currents by the inverter;

EEPROM board storages one-to-one related information of LCD (such as serial number and color temperature version, etc) and gamma correction parameters; the socket connecting to main board is defined as follows:

Table 3-41 Interfaces of Main Board and EEPROM

PIN	Definition
1	VDD
2	GND
3	SCL
4	SDA

The logic will output different RGB mapping tables according to the storage contents to ensure the consistence of image output effect for different LCDs;

Note: To ensure the display effect, when changing LCD assembly or main board assembly, enter Maintenance Menu to reload the LCD parameters. This is display parameter synchronization. The synchronization procedure is described as follows:

1. Restart the Doppler system:
2. Log onto the system as service engineer:
3. Press <F10> to open the Setup menu, see the figure below:

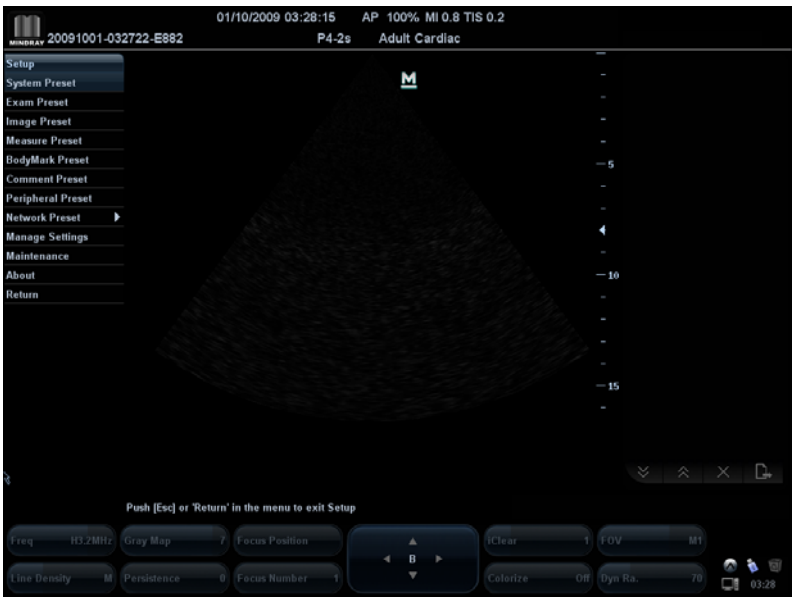


Fig 3-26 Setup Menu

4. Click [Maintenance] in the menu to open the menu in the figure below:

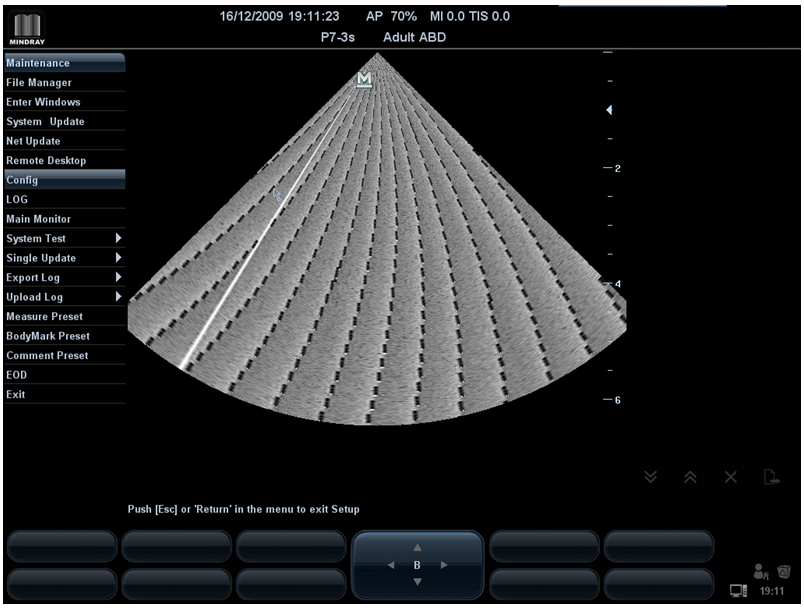


Fig 3-27 Maintenance Menu

5. Click [Monitor Test] →[Main Monitor] to open the following screen:

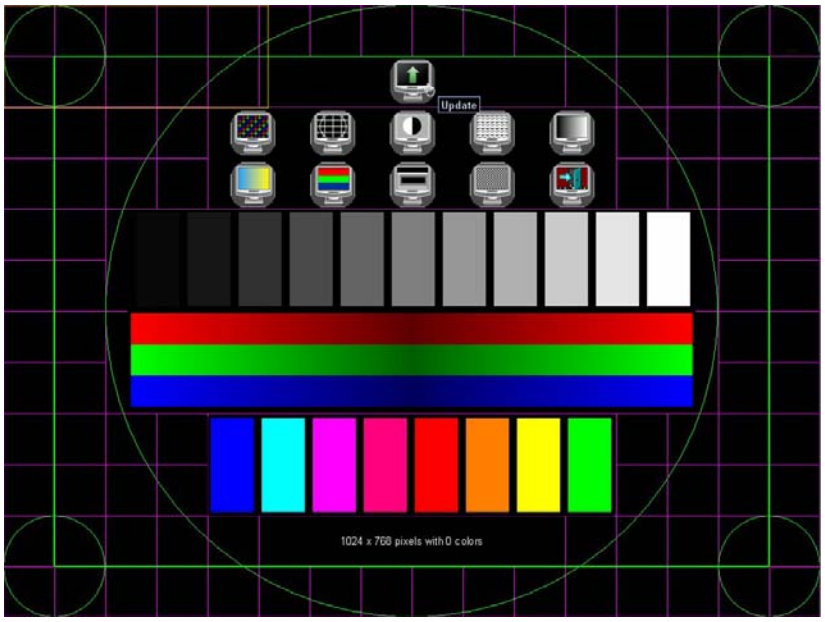


Fig 3-28 Main Screen Maintenance Screen

6. See the figure above, click the top icon on the screen (update) to start the maintenance, when completed, a dialogue box showing successful maintenance will be displayed, restart the system to make the new setting take effect. If the maintenance is failed, please return the system to development center. The following two figures show the two situations respectively.

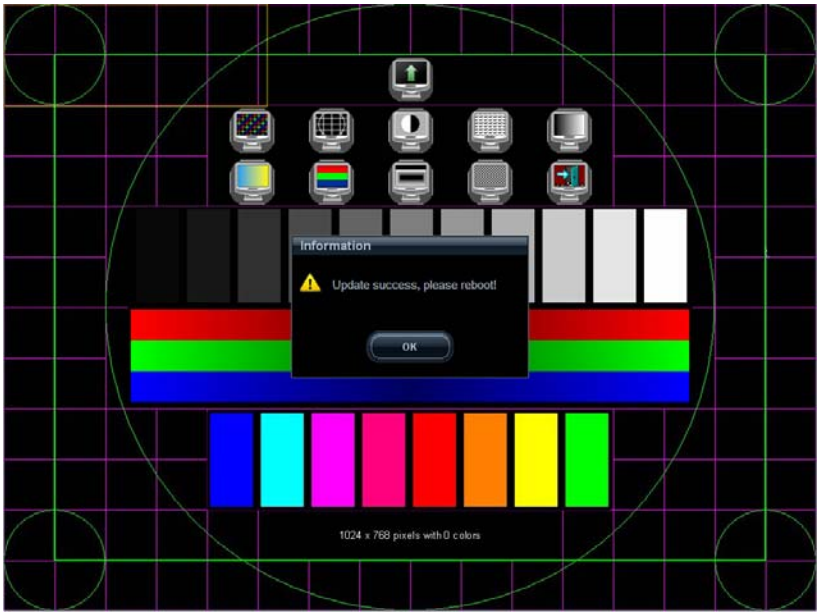


Fig 3-29 Successful Update

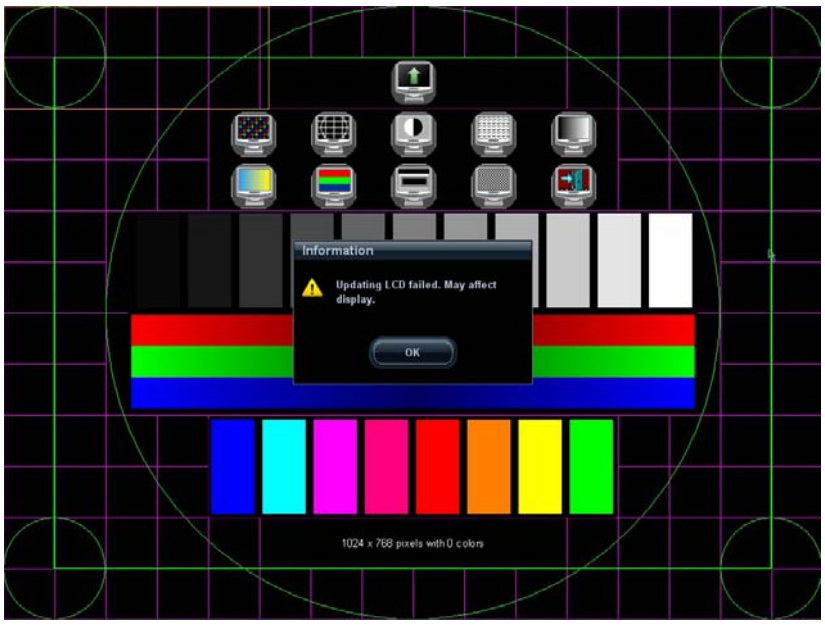


Fig 3-30 Update Failed

3.2.7 Principle of ECG Board

The function of the ECG board contains: ECG signal detection; ECG waveform display; ultrasound image reference signal; producing real-time 2-D image and color flow image synchronous signal; displaying ECG signals from external patient monitor.

After being amplified, filtered and sampled, the ECG signal is sent to host PC, and R-waveform detection is performed simultaneously. After being detected, the ECG trigger signal is sent to host PC via serial port. Block diagram is shown as follows:

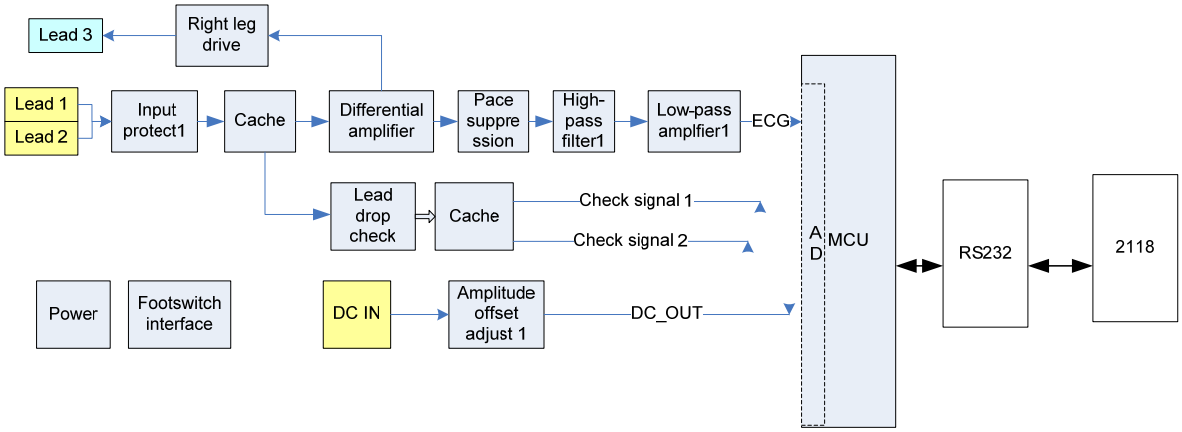


Fig 3-31 Block Diagram of the ECG Board

3.2.7.1 Power Principle of ECG Board

ECG board is powered by main unit, and the voltage is 5V. 5V is transformed to 12V after going through the step-up circuit. T1 is the isolated transformer. The 12V power is isolated and then sent to ECG board to power the analog and digital circuits. As shown in figure below.

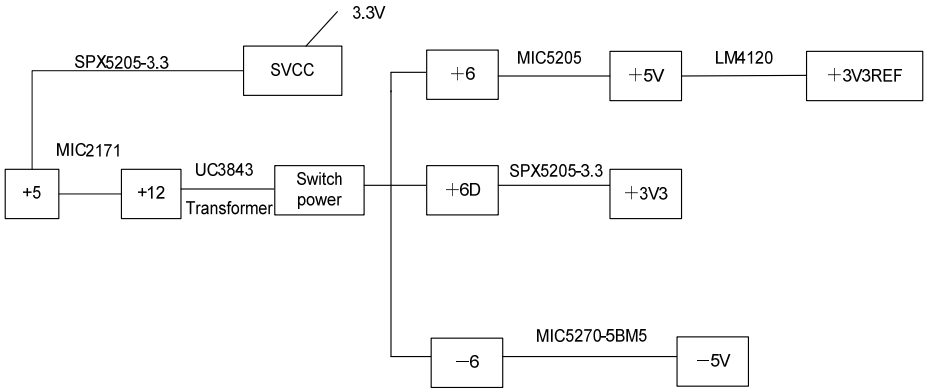


Fig 3-32 Power Functional Block Diagram of ECG Board

3.2.7.2 Instrumentation Diagram and Component Description

The instrumentation diagram of ECG board is shown in the following figure. The figure marks the sockets and their names. The blue dotted line indicates the component isolation boundary. The right isolation area indicates the power circuit and communication port, and the left isolation area indicates ECG signal processing circuit

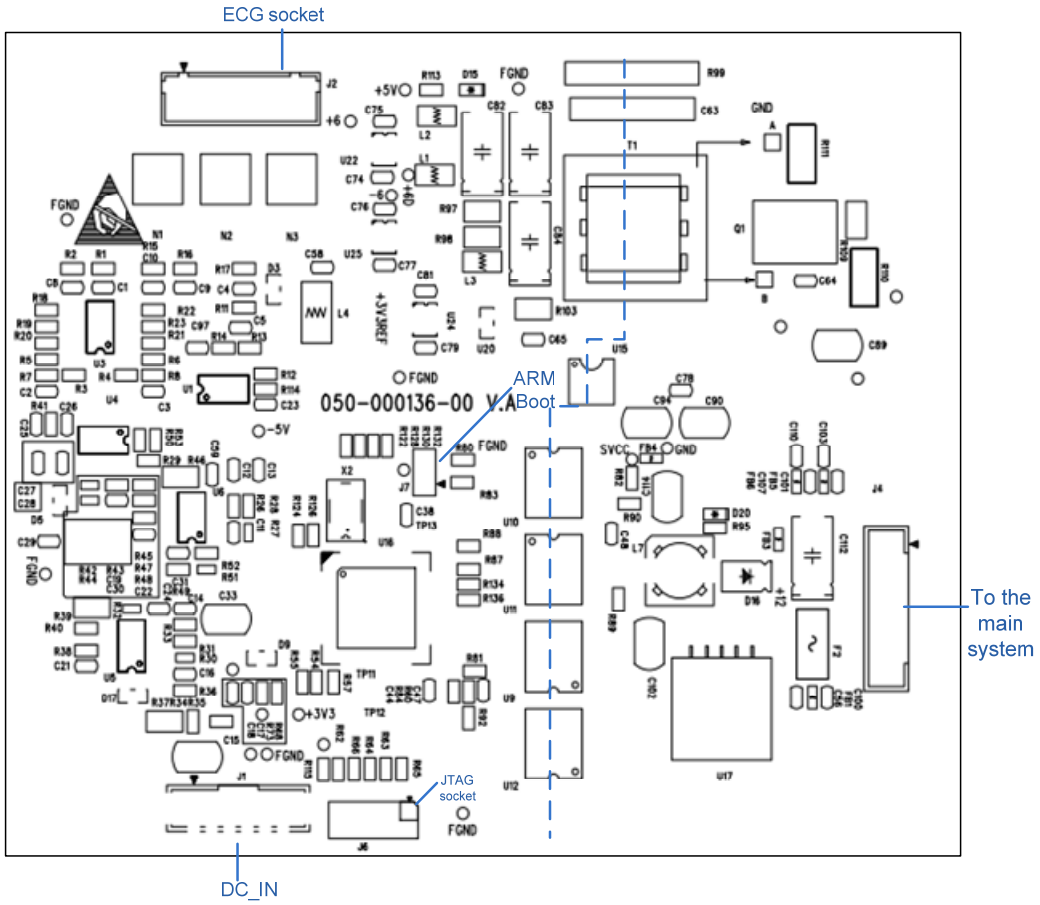


Fig 3-33 The instrumentation diagram of ECG board

The interfaces are shown in the figure, and the interfaces are defined in the following table:

Table 3-42 ECG Board Instrumentation Diagram Description

Socket number on PCB	Name	Definition of Pin			Notes
		Pin No	Definition of Pin	Description of PIN	
J1	DC_IN	1	FGND	ECG module floating ground	
		2	FGND	ECG module floating ground	
		3	DC_IN	DC IN	
		4	FGND	ECG module floating ground	
		5	FGND	ECG module floating ground	
		6	FGND	ECG module floating ground	
J2	Lead cable	1	Lead_F_IN	Lead cable 1	
		2	Lead_R_IN	Lead cable 2	

	interface socket	3	Lead_N_DR	Lead cable 3 (connected with the right) (to the right leg)	
		4	NC	No connection	
		5	C_SHIELD	Cable shield drive	
		6	NC	No connection	
J4	Main system interface socket	1	GND	Main system ground	
		2	ECG_RX	ECG signal receiving (relative to the main board)	
		3	ECG_TX	ECG signal transmitting (relative to the main board)	
		4	ECG_PWR	Power for ECG board	
		5	GND	Earth terminal of main system	
		6	NC	Earth terminal of main system	
		7	GND	Earth terminal of main system	
		8	GND	Earth terminal of main system	
J6	JTAG debugging socket	1	VCC	3.3V	Debugging
		2	GND	ECG module floating ground	
		3	TRST	JTAG——TRST	
		4	TCK	JTAG——TCK	
		5	TDI	JTAG——TDI	
		6	TDO	JTAG——TDO	
		7	TMS	JTAG——TMS	
		8	RTCK	JTAG——RTCK	
		9	NRST	JTAG——NRST	
		10	NC	No connection	
J7	ARM BOOT	1	/	Connect to LPC213X P0.14 pin of ARM chip	Service
		2	GND	ECG module floating ground	

3.2.8 Principle of Video/Audio Capture Card

The diagram of video capture card is shown in the figure below:

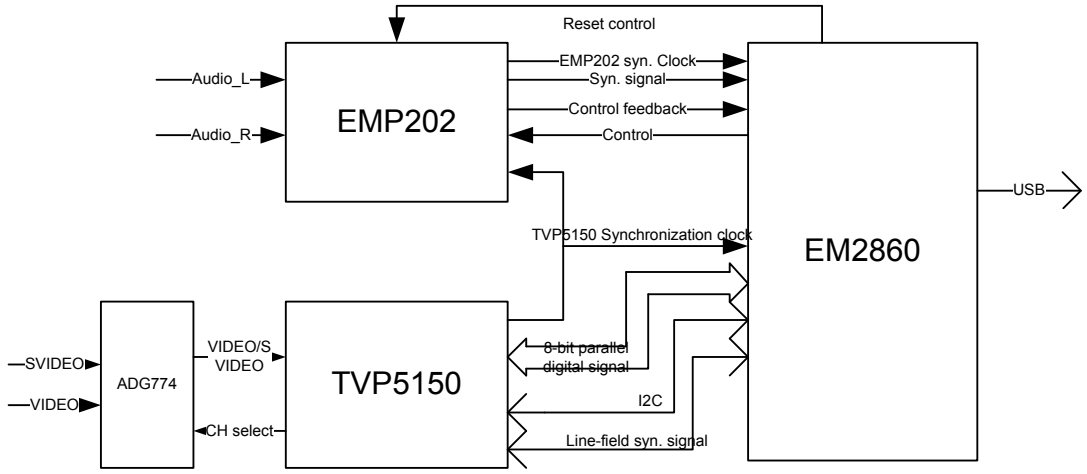


Fig 3-34 System Block Diagram of Video/Audio Capture Card

The power relation of video audio capture card is shown in the figure below:

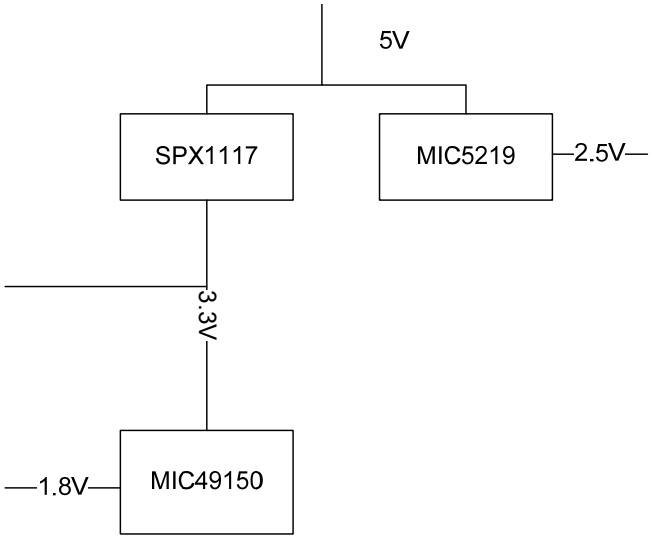


Fig 3-35 Power Relation Diagram of Video/Audio Capture Card

Principle of the video capture card is described as follows:

After the video capture card is powered on, EM2860 first resets and communicates with the main unit, and TVP5150 resets simultaneously. At this moment the system displays the newly found hardware, namely EM2860.After EM2860 resets, its GPIO1 signal will change and control the reset of EMP202 through PMOSFET.

After the process is completed, both the BCLK and VCLK have clock signals, and SYNC has cyclic pulses.

When the capture software is started, LED pin of EM2860 is pulled high, and green LED in the board is lit up. The video capture card transmits the video capture configuration in the software to TVP5150 via I2C bus. The TVP5150 sends channel selecting command to analog switch ADG774 according to the received command, and selects encoding method corresponding to configuration.

TVP5150 converts the input video signals to 8-bit digital signals, and transmits them to EM2860. At the same time, EMP202 transmits the captured audio signals to EM2860 via serial channel. EM2860 integrates the received signals and then sends them to PC via USB port.

3.2.9 Principle of the CW Board

The block diagram of CW board is shown as figure below:

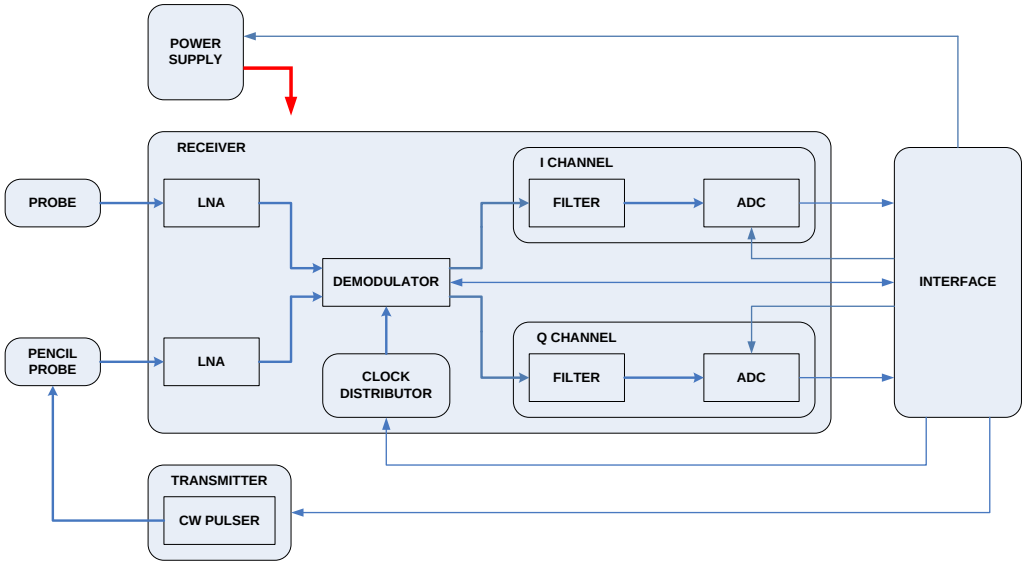


Fig 3-36 Principle Diagram of CW board

The hardware block diagram of CW board is shown as the figure above. Echo signals that received by the phased probe and pencil probe will first be amplified through low-noise-amplifying (LNA) circuit, then pass through the DEMODULATOR to obtain I, Q signals, and I, Q signals will be sampled through ADC after being filtered out the useless low-frequency and high-frequency signals. The sampled signals then will be sent through the interface for beam-forming and so on.

Low-phase noise demodulation clock is provided by the clock distributor circuit.

In addition to echo receiving, CW board is also responsible for pencil probe signal transmitting.

The control signals, as well as the data signals, are communicated with the external through interfaces

Definition of CW board interfaces is shown as follows:

Table 3-43 Pin definition of J1

1	GND	2	GND	21	GND	22	GND
3	CW19	4	CW20	23	CW9	24	CW10
5	GND	6	GND	25	GND	26	GND
7	CW17	8	CW18	27	CW7	28	CW8
9	GND	10	GND	29	GND	30	GND
11	CW15	12	CW16	31	CW5	32	CW6
13	GND	14	GND	33	GND	34	GND
15	CW13	16	CW14	35	CW3	36	CW4
17	GND	18	GND	37	GND	38	GND
19	CW11	20	CW12	39	CW1	40	CW2

Table 3-44 Pin definition of J2

1	A-5V1	2	A+5V1	21	SHUTDOWN	22	AD8339_CSB
3	A-5V1	4	A+5V1	23	GND	24	GND
5	GND	6	GND	25	TPU0_PENCIL_CW	26	AD_SCK
7	BOARDID_CW	8	PPID_CW	27	GND	28	GND
9	CWPPPRESENT	10	TUNING_SW_CW	29	GND	30	AD_CNV_CW
11	GND	12	GND	31	AD8339_4LO0_CW	32	GND
13	AD_SDO1	14	AD8339_RSTS	33	AD8339_4LO1_CW	34	AD8339_RSET
15	AD8339_SDI	16	AD8339_SCLK	35	GND	36	GND
17	GND	18	GND	37	VOL_ADJ_SDA	38	VOL_ADJ_SCK
19	AD8339_SDO	20	AD_SDO0	39	A+12V	40	A+3V6

Table 3-45 Pin definition of J3

1	CWPPPRESENT	4	PEN_EMIT
2	PPID_CW	5	GND
3	GND	6	PEN_SIGNAL

Table 3-46 Connector signal description of CW board

Name	Meaning	Direction	Type	Notes
J1				
CW[10:1]	CW IN	I（sink）	Single-end	current
CW[20:11]	CW IN	I（sink）	Single-end	Current (reserved)
J2				
A-5V1	A-5.1V power	I		Power
A+5V1	A+5.1V power	I		Power
A+12V	A+12V power	I		Power
A+3V6	A+3.6V power	I		Power
BOARDID_CW	CW board ID	I/O	Single-end	One signal device
CWPPPRESENT	Pencil probe present	O	Single-end	
AD_SDO[1:0]	AD serial port output data	O	Single-end	
AD8339_SDI	AD8339SPI daisy chain serial port input data	I	Single-end	
AD8339_SDO	AD8339SPI daisy chain serial port output data	O	Single-end	
PPID_CW	Pencil probe ID	O	Single-end	One signal device
TUNING_SW_CW	Tuning inductive relay switch	I	Single-end	
AD8339_RSTS	AD8339 internal register reset	I	Single-end	
AD8339_SCLK	AD8339 SPI data clock	I	Single-end	
TPU0_PENCIL_CW	CW pencil probe transmitting input	I	Single-end	Low-phase noise
SHUTDOWN	ENB of AD8432	I	Single-end	

AD8339_4LO[1:0]_CW	Input demodulation clock	I	difference	Variable-frequency, low-phase noise
AD8339_CSB	AD8339 SPI CS (chip selection)	I	Single-end	
AD_SCK	ADC data clock	I	Single-end	I/Q share
AD_CNV_CW	ADC sample clock input	I	Single-end	I/Q share, low-phase noise
AD8339_RSET	AD8339 internal LO reset	I	Single-end	
VOL_ADJ_SDA	I2C data line of digital potentiometer AD5259	I/O	Single-end	I2C
VOL_ADJ_SCK	I2C clock line of digital potentiometer AD5259	I/O	Single-end	I2C
J3				
PEN_SIGNAL	Pencil probe input signal	I	Single-end	
PEN_EMIT	Pencil probe transmit signal	O	Single-end	
PEN_ID	Pencil probe ID	I	Single-end	
PEN_PRESENT	Pencil probe present signal	I	Single-end	

4 Structure and Assembly/Disassembly

4.1 Explosive Figure of the Structure

4.1.1 Explosive Figure of the Complete System

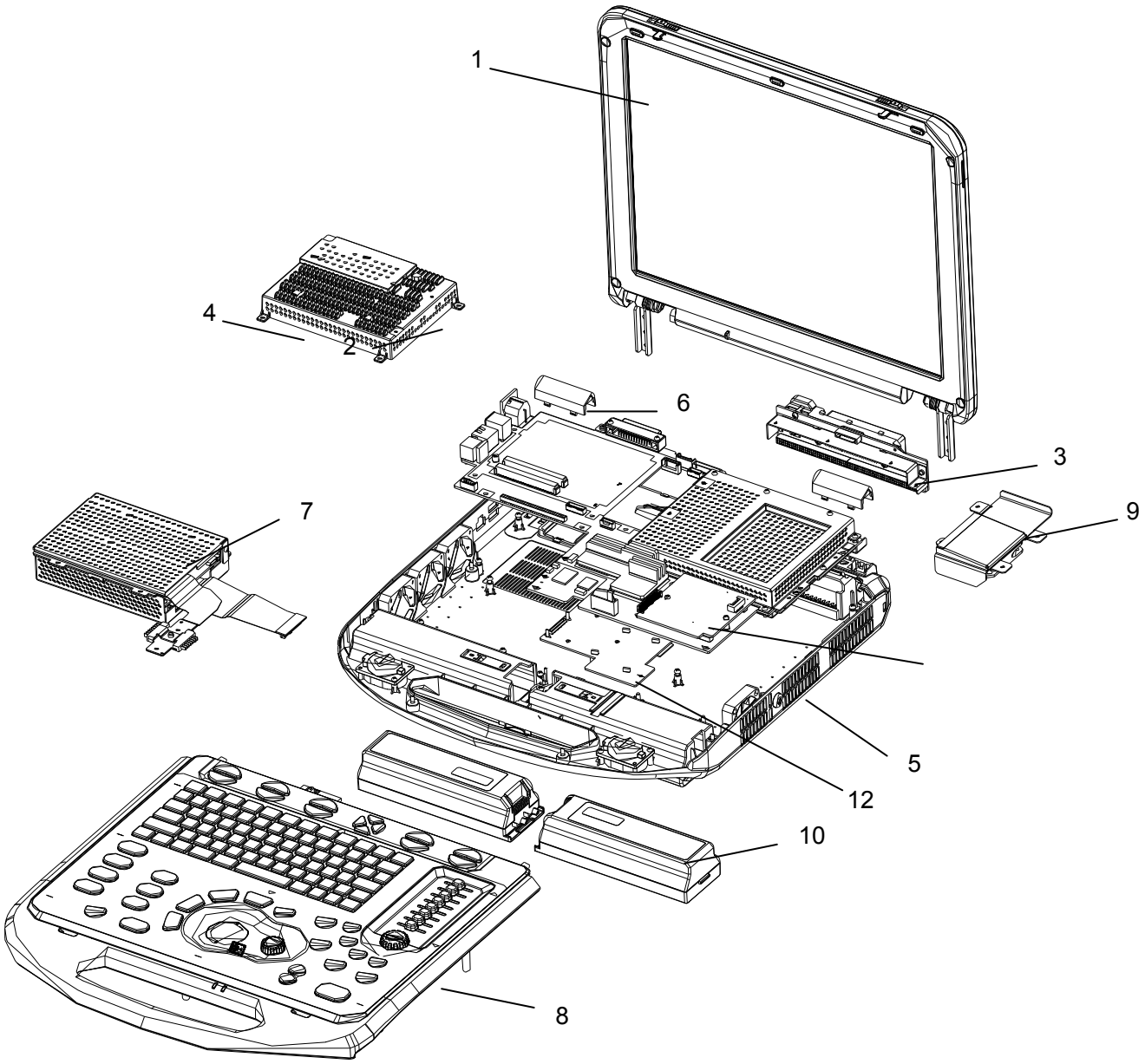


Fig 4-1 Overall exploded view

No.	Name	No.	Name	No.	Name
<1>	Display assembly 115-002254-00	<2>	Main board 051-000098-01	<3>	Transducer board assembly 115-002943-00
<4>	CPU board and radiator module 115-003754-00	<5>	Rear cover assembly of main unit 034-000041-00	<6>	Damping axis cover 043-000453-00

<7>	Power supply module; 115-002256-00	<8>	Top cover assembly of main unit 115-002942-00	<9>	Fan mounting bracket of CPU module 042-000415-00
<10>	Battery 2108-20-65792	<11>	CW board PCBA 051-000170-00	<12>	4D board PCBA 051-000102-01

4.1.2 Explosive Figure of the Modules

4.1.2.1 Explosive Figure of the Power Module

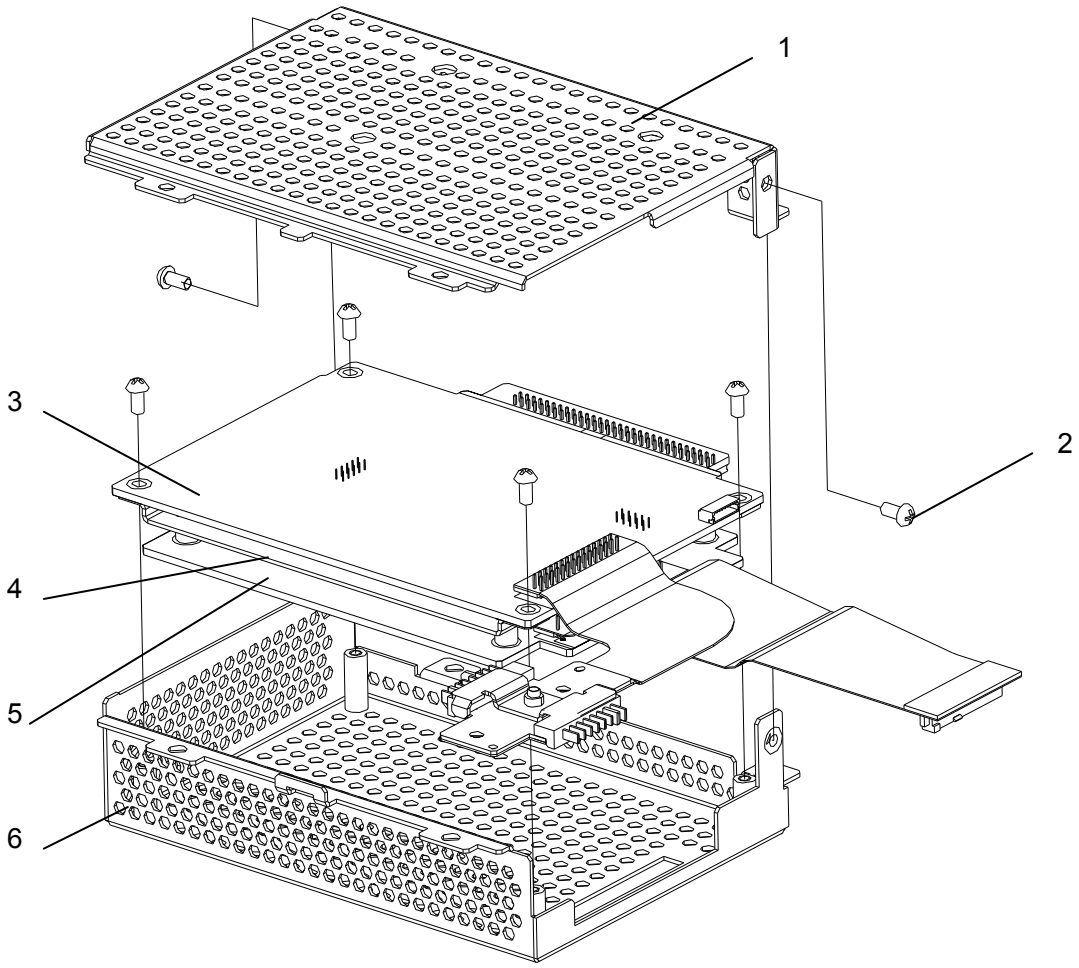


Fig 4-2 Explosive figure of the power system

No.	Name	No.	Name	No.	Name
<1>	Top cover of power box	<2>	Philips panhead screw M3×6	<3>	Power supply main board

<4>	Separating plate.	<5>	Power supply auxiliary board	<6>	Bottom cover of power box

4.1.2.2 Explosive Figure of Main Unit Top Cover

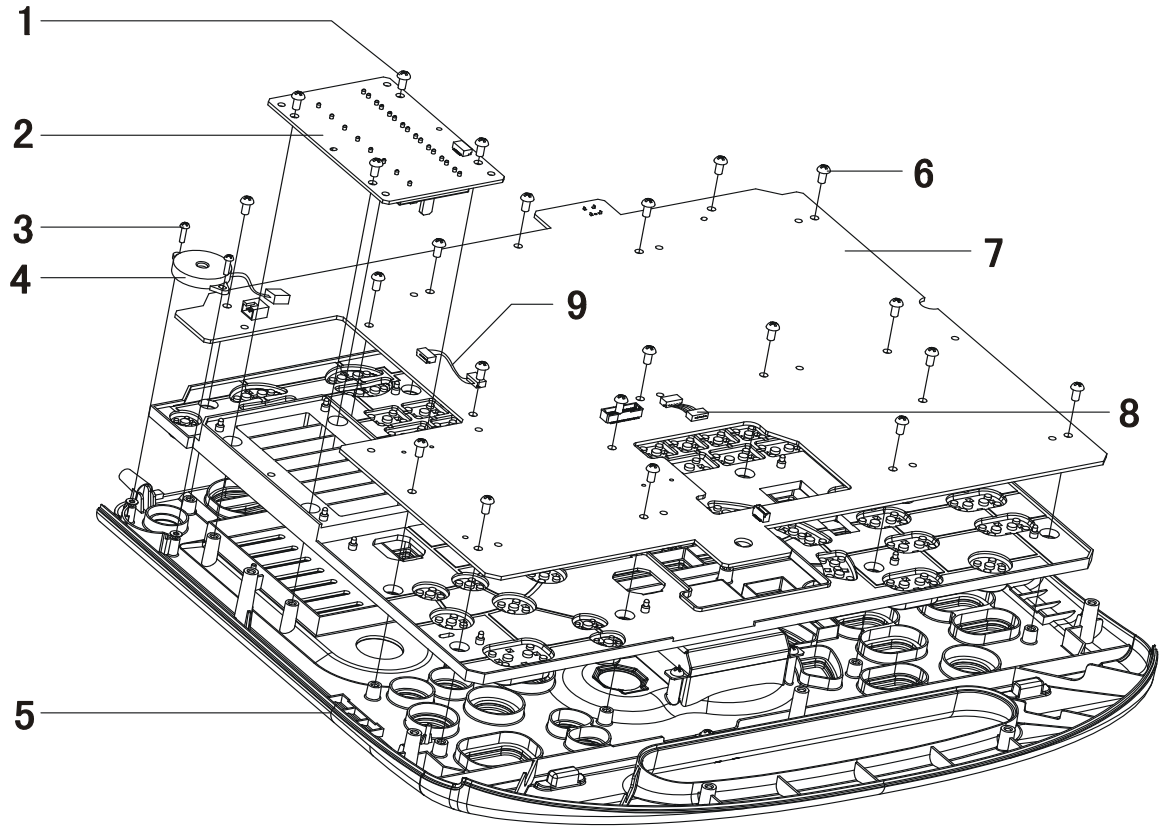


Fig 4-3 Explosive figure of the main unit top cover

No.	Name	No.	Name	No.	Name
<1>	Philips panhead screw M3×6	<4>	Buzzer	<7>	Control panel
<2>	TGC adjusting board	<5>	Top cover of main unit	<8>	Trackball connection wire
<3>	Philips panhead screw M2×10	<6>	Philips panhead screw M3×6	<9>	STC connection wire

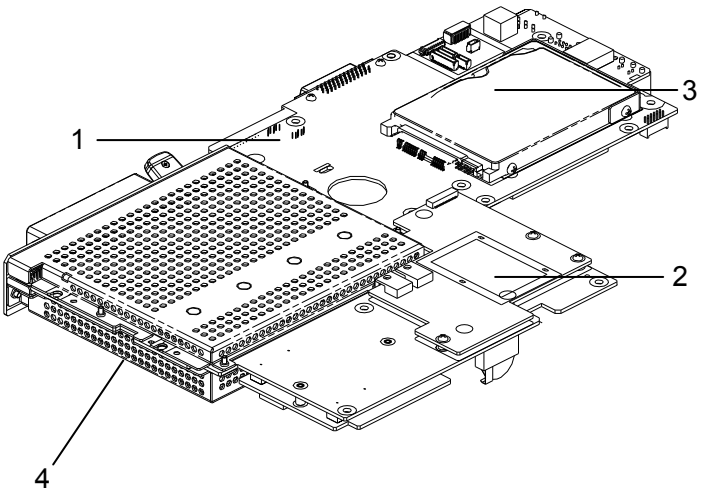


Fig 4-4 Explosive figure of the main unit

No.	Name	No.	Name
<1>	Main board	<2>	4D board
<3>	HDD	<4>	Transmitting board shielding cover

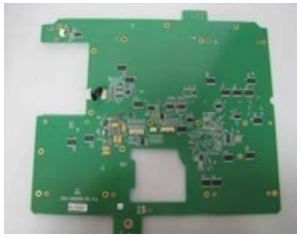
4.2 Field Replaceable Unit

NO.	Classification	Description	Order Number	Photo	Model	Compatibility	Assembly/ Disassembly
1.1	Main unit related	Main Board	801-2118-00006-00		M7、M7T	Includes button battery and jumper	Refer to 4.3.11
1.2		CPU module	801-2118-00011-00		M7、M7T		Refer to 4.3.7
1.3		HDD	115-018485-00		M7、M7T	Mark the following when apply: software version (Human use or Vet), machine type: human; Configuration type: FDA. Not include metal support	Refer to 4.3.14
			115-018486-00		M7Vet	Mark the following when apply: software version (Human use or Vet), machine type: Vet; Configuration type: FDA. Not include metal support	

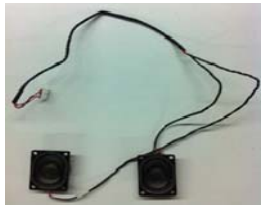
NO.	Classification	Description	Order Number	Photo	Model	Compatibility	Assembly/ Disassembly
1.3		HDD	115-018487-00		M7、M7T	Mark the following when apply: software version (Human use or Vet), machine type: human; Configuration type: CE. Not include metal support	Refer to 4.3.14
			115-018488-00		M7Vet	Mark the following when apply: software version (Human use or Vet), machine type: Vet; Configuration type: CE. Not include metal support	
1.4		Transmission Board	801-2118-00004-00		M7、M7T	Mark software version when apply	Refer to 4.3.10
1.5		Probe board assembly	801-2118-00013-00		M7、M7T		Refer to 4.3.12

NO.	Classification	Description	Order Number	Photo	Model	Compatibility	Assembly/ Disassembly
1.6		CW board	801-2118-00030-00		M7、M7T		Refer to 4.3.5
1.7.1		4D and TEE board assembly	801-2118-00036-00		M7、M7T	Support TEE probe and 4D probe	Refer to 4.3.13
1.7.2		4D board assembly	801-2118-00031-00		M7、M7T	Not support TEE probe	Refer to 4.3.13
2.1	Power related	Power supply module	801-2118-00001-00		M7、M7T	Mark software version when apply	Refer to 4.3.4

NO.	Classification	Description	Order Number	Photo	Model	Compatibility	Assembly/ Disassembly
2.2		Adapter （ADP1210-01）	801-2108-00049-01		M7、M7T		/
2.3.1		Rechargeable Li-ion Battery Pack	2108-30-66176		M7、M7T	For CE Two batteries should be replaced together	Refer to 4.3.1
2.3.2		Rechargeable Li-ion Battery Pack	115-010085-00		M7、M7T	For FDA Two batteries should be replaced together	Refer to 4.3.1
3.1	Control panel related	Control panel assembly	801-2118-00035-00		M7、M7T	Not included KeyBoard signal cable	Refer to 4.3.3

NO.	Classification	Description	Order Number	Photo	Model	Compatibility	Assembly/ Disassembly
3.2.1		Control panel PCBA (EAF196)	801-2118-00027-00		M7、M7T	If the Silicon keypad is 801-2118-00028-00(049-000113-00), you should apply this part.	Refer to 4.3.3.2
3.2.2		Control panel PCBA	801-2118-00007-00		M7、M7T	Stop production, plese replace Control panel assembly	Refer to 4.3.3.2
3.3.1		Silicon keypad(EAF196)	801-2118-00028-00		M7、M7T	If the Control panel PCBA is 801-2118-00027-00(051-000095-02), you should apply this part.	Refer to 4.3.3.2
3.3.2		Silicon keypad	801-2118-00010-00		M7、M7T	Stop production, please replace Control panel assembly	Refer to 4.3.3.2
3.4		Optical trackball unit	801-2118-00009-00		M7、M7T	Not include Trackball connecting cable	Refer to 4.3.3.1

NO.	Classification	Description	Order Number	Photo	Model	Compatibility	Assembly/ Disassembly
3.5		TGC Board	801-2108-00014-00		M7、M7T	Not include connecting cable	Refer to 4.3.3.2
4.1	Display related	LCD assembly	801-2118-00012-00		M7、M7T		Refer to 4.3.2
5.1	Others	Fan	801-2118-00015-00		M7、M7T	CPU fun	Refer to 4.3.6
5.2		Fan & Connect Wire	801-2108-00052-00		M7、M7T	Right fun	Refer to 4.3.8

NO.	Classification	Description	Order Number	Photo	Model	Compatibility	Assembly/ Disassembly
5.3		Fan & Connect Wire	115-020423-00		M7、M7T	Left fan (3 as a group)	Refer to 4.3.8
5.4		speaker	801-2108-00019-00		M7、M7T		
6.1	Accessories related	IO Extend Module	115-003485-00		M7、M7T	For CE	Refer to 4.3.18
6.2			115-003486-00		M7、M7T	For FDA	
6.3		Video Extend Module	2108-30-66045		M7、M7T	For CE	Refer to 4.3.17
6.4			2108-30-66211		M7、M7T	For FDA	
6.5		ECG module	115-003488-00		M7、M7T	For CE, AHA ECG lead	Refer to 4.3.16
6.6			115-003489-00		M7、M7T	For CE, IEC ECG lead	

NO.	Classification	Description	Order Number	Photo	Model	Compatibility	Assembly/ Disassembly
6.7			115-003490-00		M7、M7T	For FDA, AHA ECG lead	
6.8		Wireless card	115-005370-00		M7、M7T		/
6.9		M7 Probe extend module	115-006962-00		M7、M7T	For CE	Refer to UMT-300 mobile trolley service manual
6.10			115-006966-00		M7、M7T	For FDA	
6.11		M7 Probe extend module (PEM-21) for UMT-200	115-009385-00		M7、M7T	For CE	Refer to M7 Probe Expander UMT-200 installation manual
6.12			115-009386-00		M7、M7T	For FDA	

4.3 Assembly/Disassembly

This section describes the disassembling and assembling of the main modules and boards. The assembling is the inverse process of disassembling if not mentioned in particular.

4.3.1 Removing Batteries

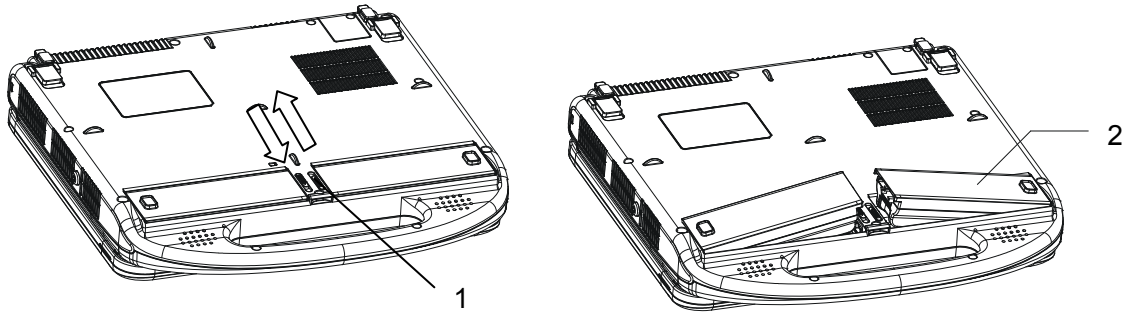


Fig 4-5 Removing the battery

Move the two battery buckles in the direction as shown in the figure above, then take out the battery.

No.	Name	No.	Name
<1>	Battery Buckle	<2>	Battery

4.3.2 Removing Display Assembly

As shown in below, remove the screws and the bottom cover and cable cover;

Disconnect the display signal cable and power cord connectors.

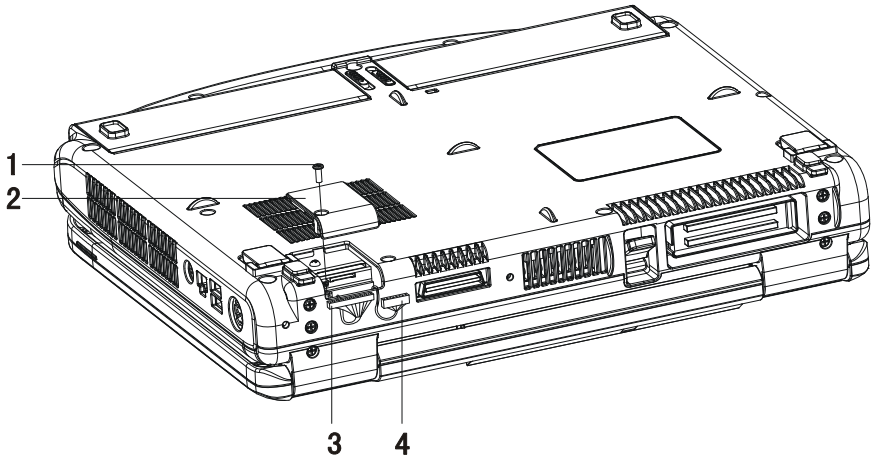


Fig 4-6 Removing Cables Cover at the Bottom Side

No.	Name	No.	Name
<1>	Screws M3×8	<2>	Cable cover
<3>	Display signal cable connector	<4>	Display power cord connector

1. As shown in figure below, open the display to the biggest angle, press down the damping axis cover to pop up the damping axis cover; take out the damping axis cover upward.

There are left and right damping axes, and they can be removed with the same method.

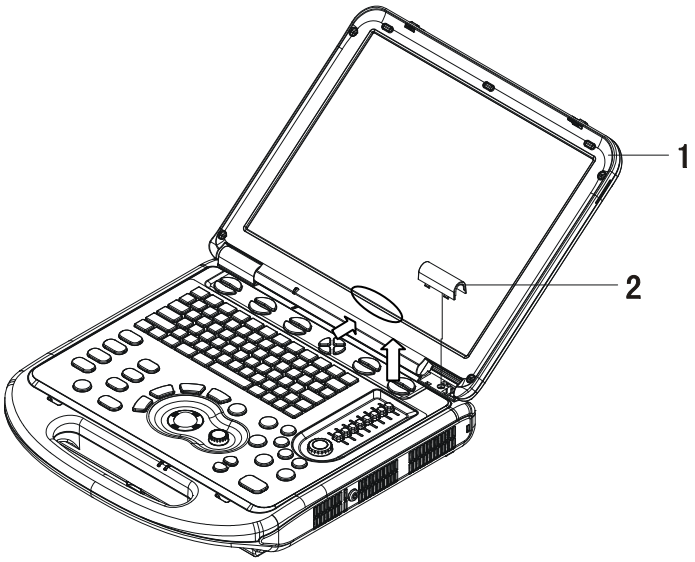


Fig 4-7 Removing the Damping Axis Cover

No.	Name	No.	Name
<1>	Main unit assembly	<2>	Damping axis cover

2. As shown in figure below, remove the six M3×8 screws; take out the display assembly upward from the assembly. Pay attention not to damage the display signal cable, power cord, and connectors during removal.

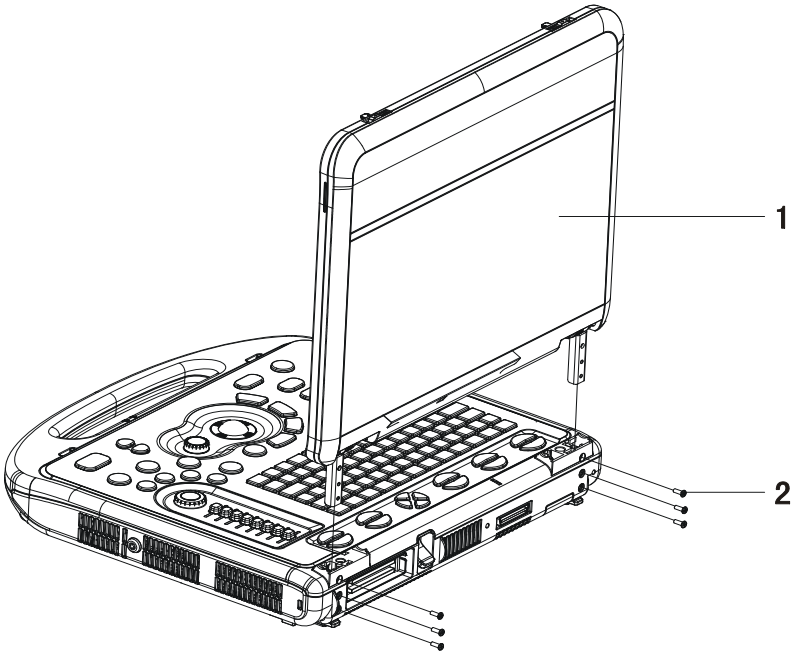


Fig 4-8 Disassembling Display Assembly

No.	Name	No.	Name
<1>	Display assembly	<2>	Screw M3×8

3. As shown in figure below, take out the the screw caps securing the display, remove the four M3×8 screws, and then take out the display front cover from the back cover.

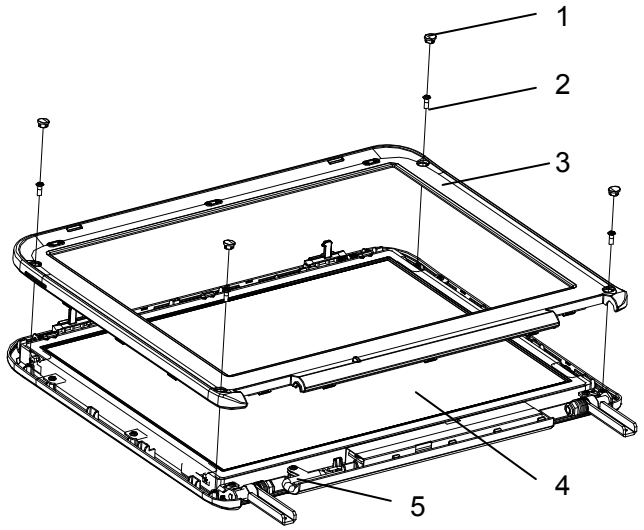


Fig 4-9 Removing Display Front Cover

No.	Name	No.	Name
<1>	Display screw cap	<2>	Screw M3×8

<3>	Display front cover	<4>	LCD assembly
<5>	Display back cover		

Note: A hook is used to connect the front cover with back cover. It is recommended that you first pry the lower-left corner and lower-right corner.

4. Remove the 2 screws fixing the inverter board of the LCD, and remove the 1 screw from the cable clip, then remove the power cable of the backlight of the LCD, and then remove the inverter board.

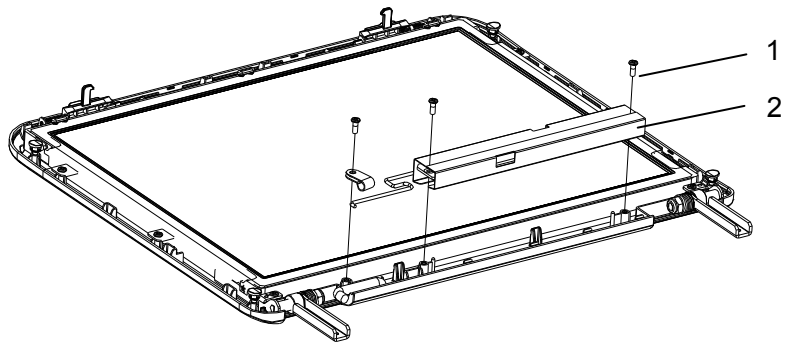


Fig 4-10 Removing the Inverter

No.	Name	No.	Name
<1>	Screw M3×8	<2>	LCD display backlight inverter

As shown in figure below, remove one screw to loose the clip fixing LCD display cable, and then take out the cable.

Remove the 4 screws and remove the LCD.

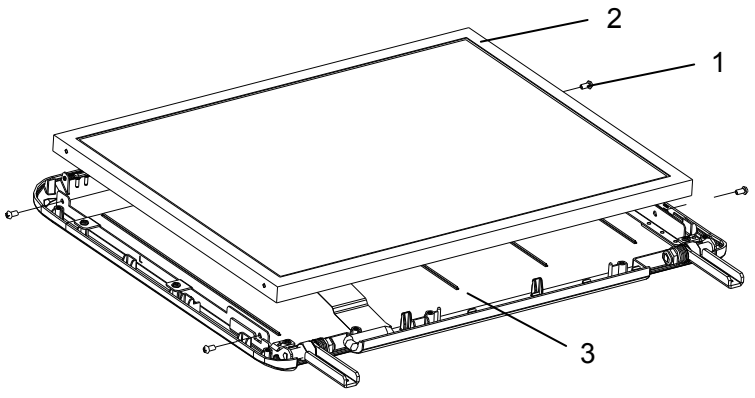


Fig 4-11 Removing the LCD

No.	Name	No.	Name
<1>	Screw M3×8	<2>	LCD

<3>	Display back cover		

5. As shown in figure below, remove the six screws, and take out the left and right damping axes.

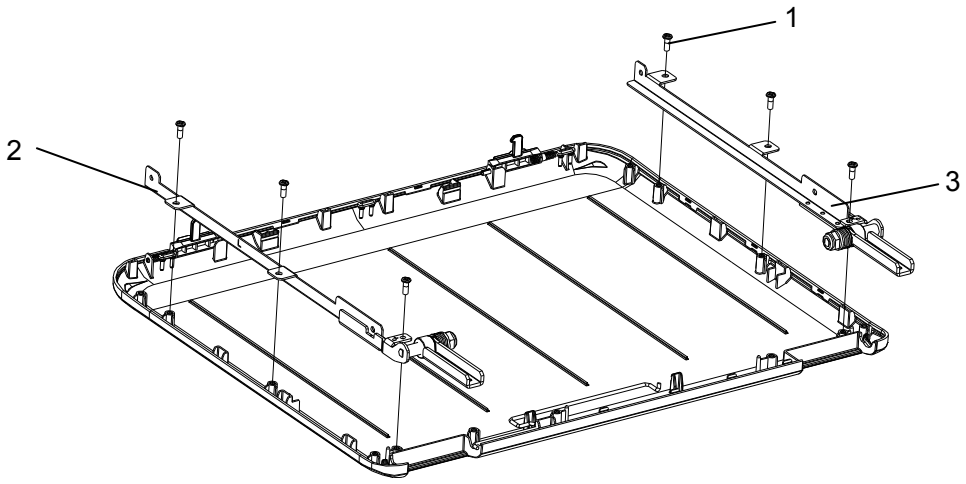


Fig 4-12 Removing the Left/right Damping Axis

No.	Name	No.	Name
<1>	Screw M3×8	<2>	Left damping axis
<3>	Right damping axis		

6. Take off the LCD screen, the back side view is as shown in figure 4-13.

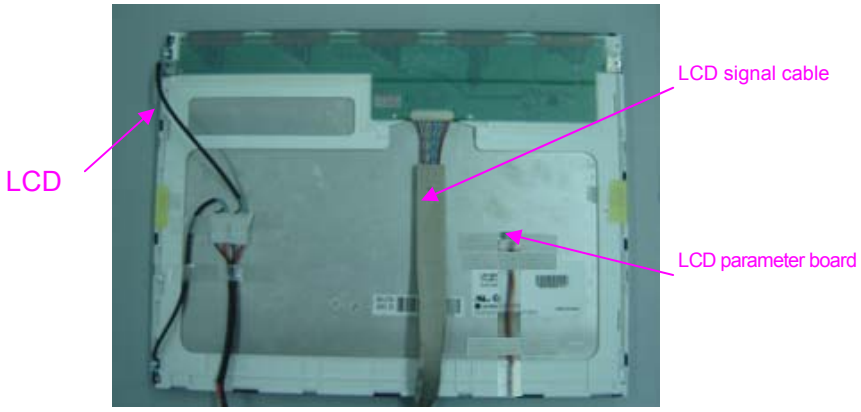


Fig 4-13 Backside of LCD Screen

NOTE: 1. The whole LCD module should be replaced in the maintenance. The corresponding LCD parameter board should be replaced once the LCD is replaced, since the two is bonded together.
2. Before replacing, make sure the module has passed the test and the related parameters have been burnt on the LCD parameter board.

7. According to figure below, first press the spring in axial direction, wait until the shorter axis comes out, and then take out the hook upward.

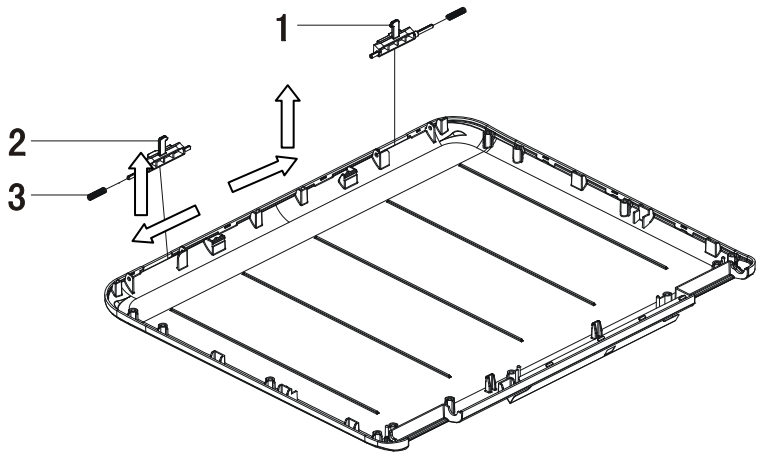


Fig 4-14 Removing Hooks of Display

No.	Name	No.	Name	No.	Name
<1>	Right display hook	<2>	Left display hook	<3>	Display hook spring

NOTE: After replacing the LCD module, start up the system and updates the LCD by entering [Maintenance] -> [Main Monitor], and clicking the update button on the top of the screen.

4.3.3 Removing Top Cover of Main Unit

1. As shown in figure below, remove the 9 screws.

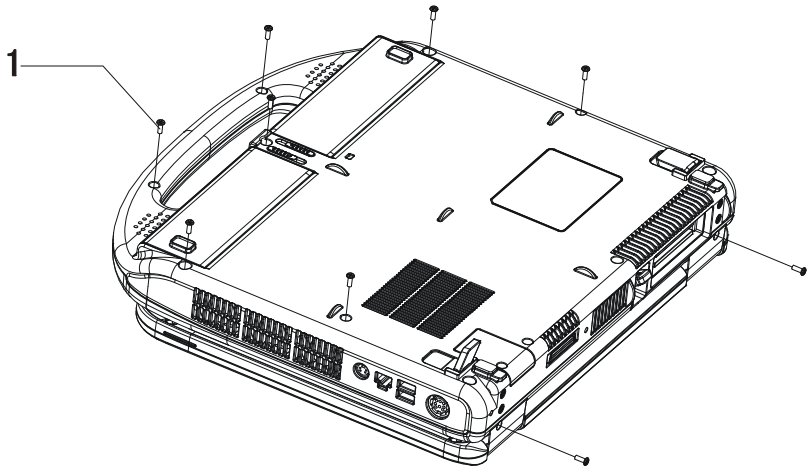


Fig 4-15 Removing the Top Cover Assembly of Main Unit (1)

No.	Name	No.	Name
<1>	Screw M3×8		

2. Lift up the main unit top cover for 30 degrees, disconnect the wire between the control panel and main board; pull it out in the direction as per the figure, and then take out the main unit top cover.

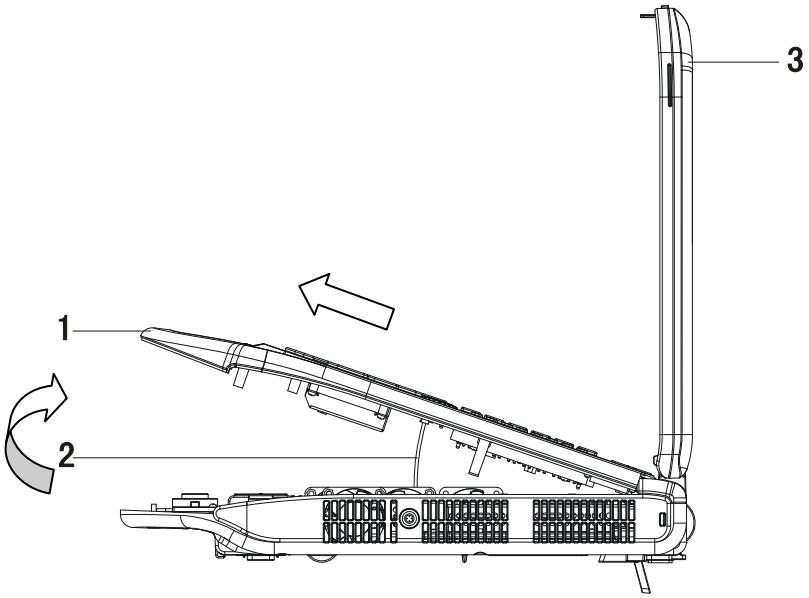


Fig 4-16 Removing the Top Cover Assembly of Main Unit (2)

No.	Name	No.	Name
<1>	Top cover assembly of main unit	<2>	Connective cable between control panel and main board
<3>	Display		

4.3.3.1 Removing the Trackball

As shown in figure below, pull out the socket of the trackball and remove the screws fixing the trackball, and then remove the optical trackball.

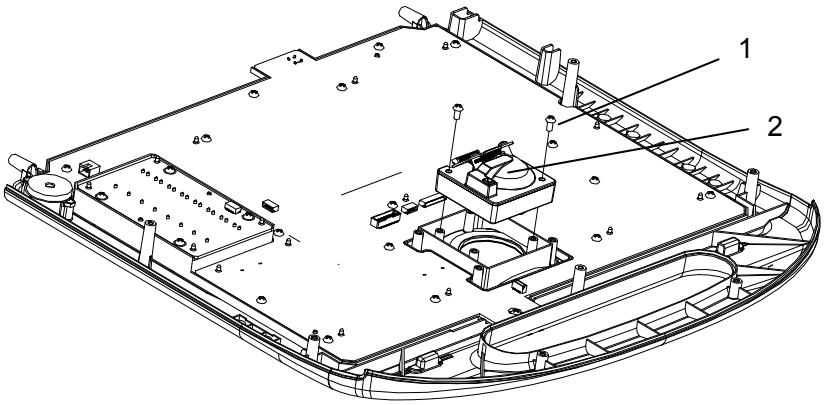


Fig 4-17 Removing the Trackball

No.	Name	No.	Name
<1>	Philips panhead screw M3×6	<2>	Trackball

4.3.3.2 Removing Control Panel and TGC Board

1. As shown in figure below, remove TGC sliders, big encoder knob, small encoder knob, big encoder button, small encoder button. When removing the encoder knob, please pry it at one end of the knob.).

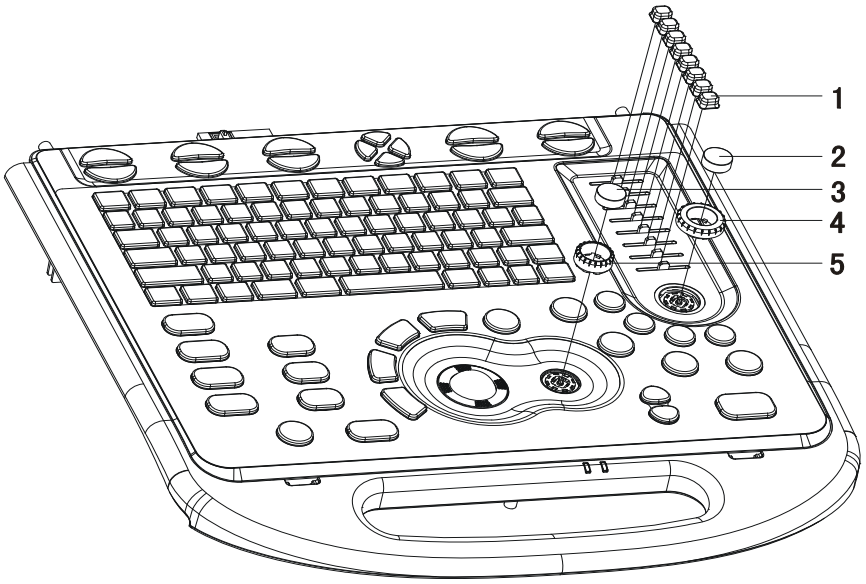


Fig 4-18 Removing the TGC Sliders, Encoder Knob and Button

No.	Name	No.	Name
<1>	TGC sliders	<2>	Big encoder button
<3>	Small encoder button	<4>	Big encoder button
<5>	Small encoder button		

2. As shown in figure below, disconnect the STC cable, trackball cable and buzzer cable; remove the screws fixing the buzzer and then remove the buzzer; remove the screws fixing the TGC adjusting board and the control panel and then remove the TGC adjusting board and the control panel.

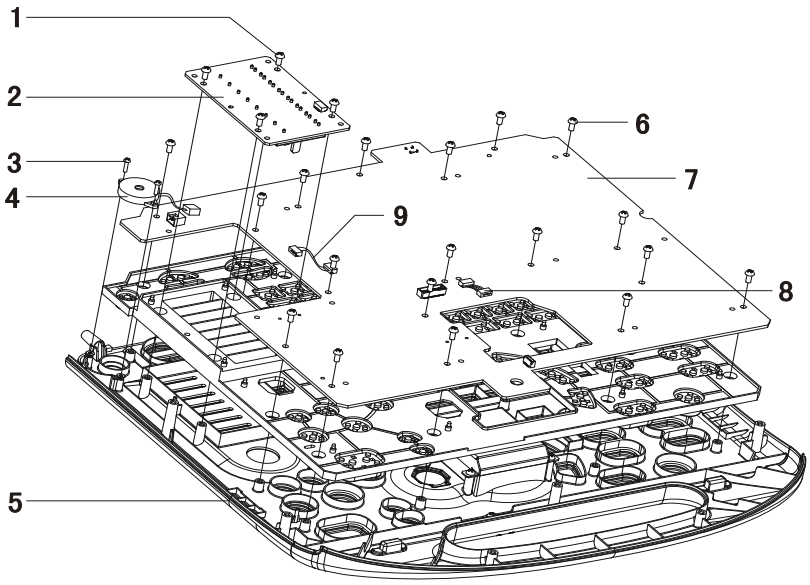


Fig 4-19 Removing TGC Adjusting Board and Control Panel

No	Name	No.	Name	No.	Name
<1>	Philips panhead screw M3×6	<4>	Buzzer	<7>	Control panel
<2>	TGC adjusting board	<5>	Top cover of main unit	<8>	Trackball connection wire
<3>	Philips panhead screw M2×10	<6>	Philips panhead screw M3×6	<9>	STC cables

4.3.4 Removing the Power Module

1. According to 4.3.3, remove the top cover of the main unit;
2. As shown in figure below, remove the four M3×6 Philips panhead screws to take out the power module from the main board.

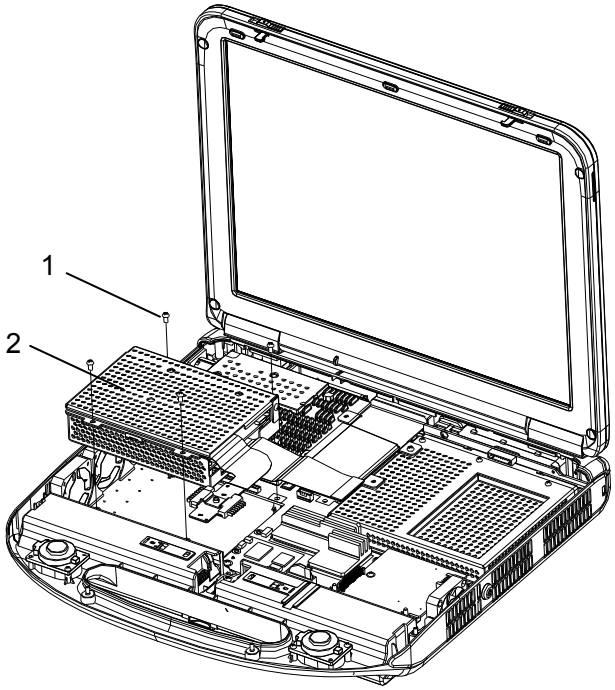


Fig 4-20 Removing the Power Module

No.	Name	No.	Name
<1>	Philips panhead screw M3×6	<2>	Power supply module;

Note: When removing the power module, keep the power board horizontally to prevent damaging the connector pins.

4.3.4.1 Remove the Battery Socket Pressing Board

See figure below, remove the 1 Philips panhead screw M3×6, and then remove the battery socket pressing board from the flexible board for connecting the batteries.

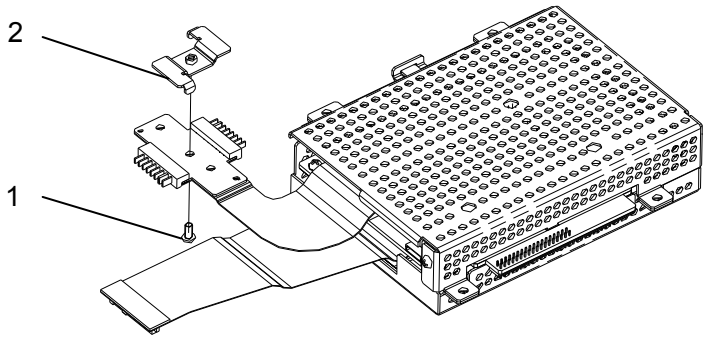


Fig 4-21 Remove the Battery Socket Pressing Board

No.	Name	No.	Name
<1>	Philips panhead screw M3×6	<2>	Battery socket pressing board

4.3.4.2 Disassembling Power Module

1. As shown in figure below, remove the 2 screws 5 to remove the top cover of the power module; remove the 4 screws 2 to take out the power board, separating board and auxiliary board assembly.

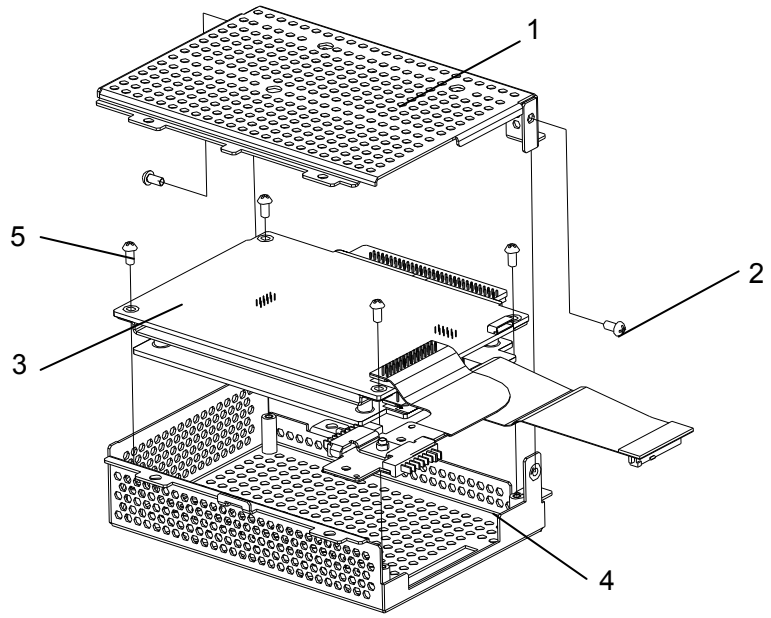


Fig 4-22 Disassembling the Power Module

No.	Name	No.	Name	No.	Name
<1>	Top cover of power box	<2>	Philips panhead screw M3×6	<3>	Power main board, separating board, and auxiliary board
<4>	Bottom cover of power box	<5>	Philips panhead screw M3×6		

2. As shown in figure below, remove the 8 screws to disconnect the connector between the main power board and auxiliary power board.

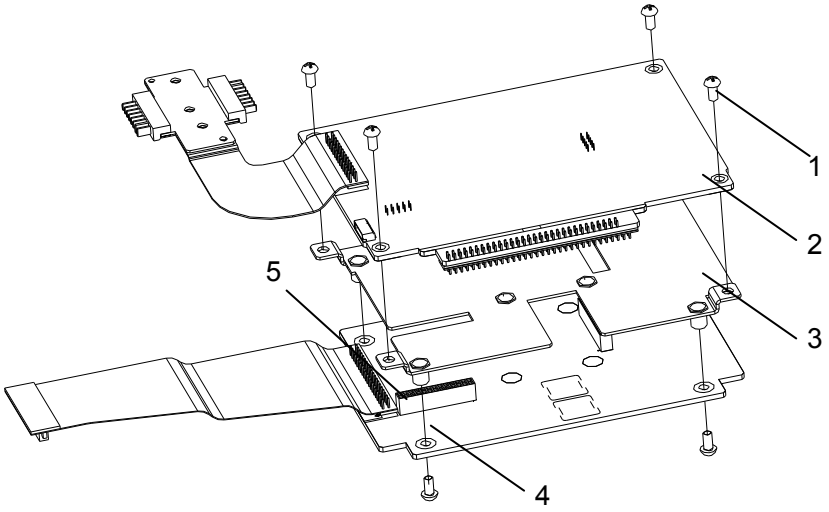


Fig 4-23 Disassembling Main Power Board, Separating Board and Auxiliary Board

No.	Name	No.	Name	No.	Name
<1>	Philips panhead screw M3×6	<2>	Main power board	<3>	Power separating board
<4>	Auxiliary power board	<5>	Connector of power main board		

4.3.5 Removing CW Board and Installation

◆Removing

Remove the two Philips panhead screws fixing the CW board, and take out the CW board upward.

Note: If a pencil probe is configured with the system, you shall first disconnect the pencil probe connector before removing the continuous wave Doppler board.

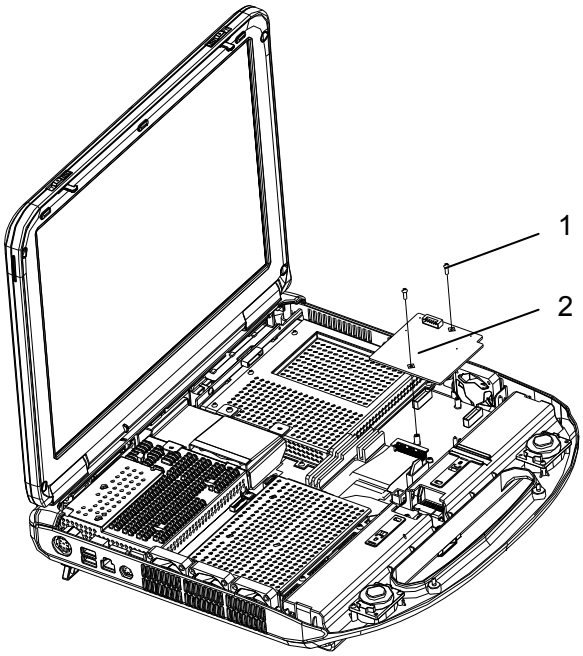
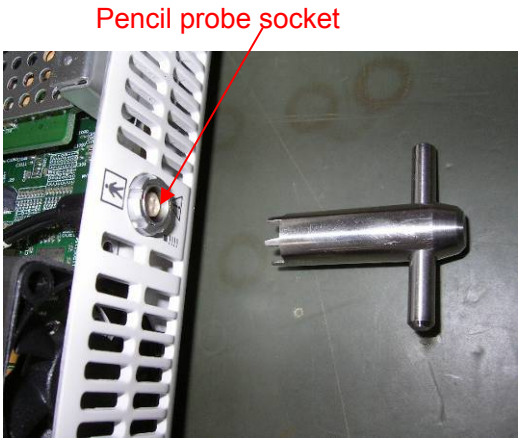


Fig 4-24 Removing CW Board

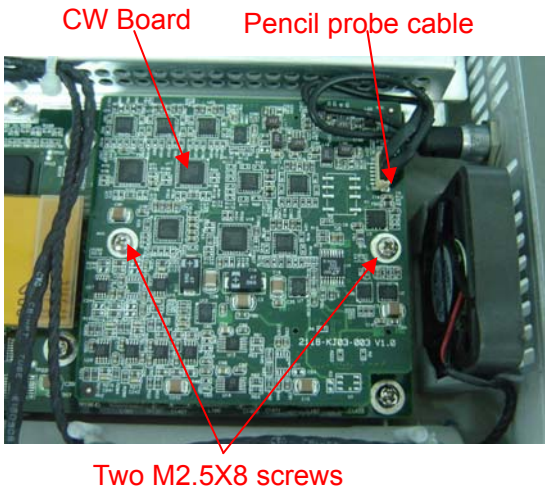
No:	Name	No.	Name
<1>	Philips panhead screw M2.5×8	<2>	CW board

◆Installation

1. If pencil probe is optional configured, remove the top of pencil probe hole in the rear cover assembly of main unit, then install the pencil probe socket (The gap of socket is up),as shown in the figure.



2. Use two M2.5X8 panhead screws to fix the CW board. (If pencil probe is optional configured, plug the pencil probe cable into the socket on the CW board and then tidy up the cable）.



4.3.6 Removing CPU Fan

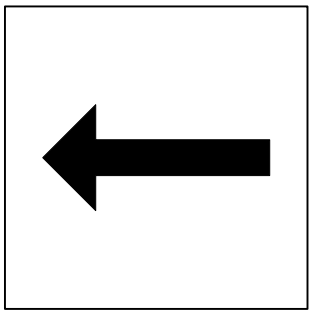
As shown in 4.3.3, remove the top cover assembly of main unit;

As shown in figure below, pull out the CPU fan connector,

Remove the 4 screws of fan fixing bracket and 2 insulation grains on the left, and remove fan fixing bracket and CPU fan and connection wire from the main board;

Take away the 4 CPU fan screws, and then remove the CPU fan.

Note: when install the lateral side fan, make sure the fan direction is the same as shown in the figure below.



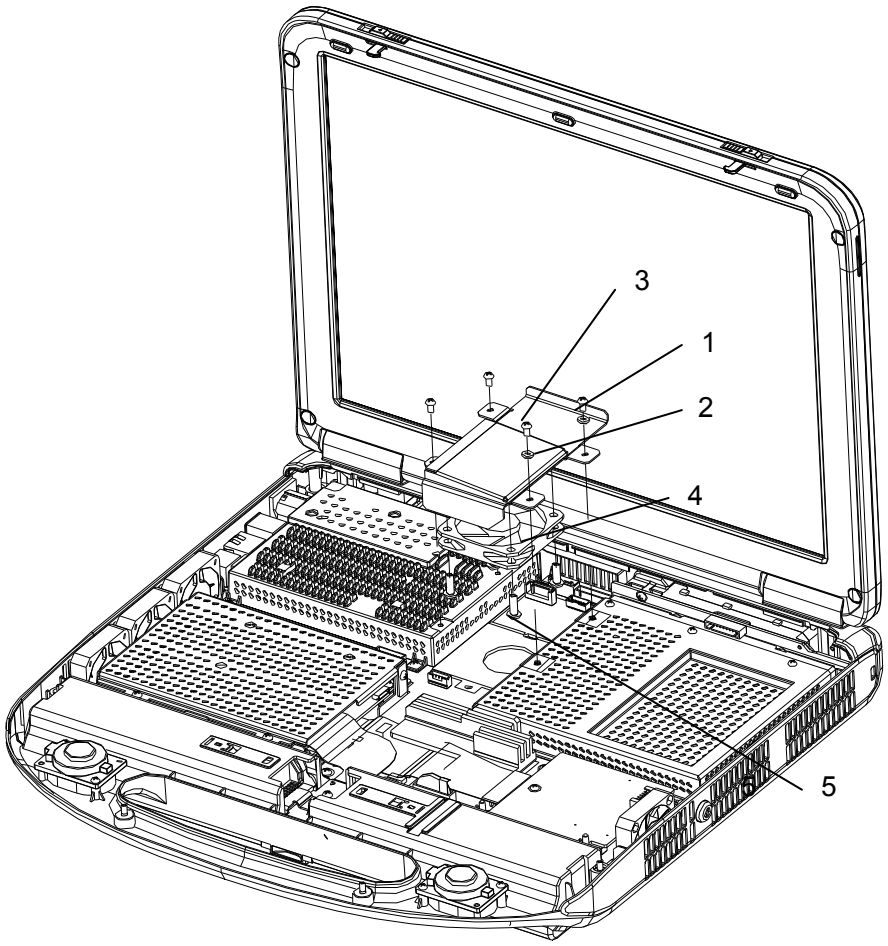


Fig 4-25 Removing CPU Fan

No.	Name	No.	Name
<1>	Philips panhead screw M3×6	<2>	Insulation particles
<3>	Fan fixing bracket	<4>	CPU fan and cable
<5>	Philips panhead screw M4×10		

4.3.7 Removing CPU Board and Radiator Module

1. According to 4.3.3, remove the top cover of the main unit;

2. As shown in figure below, first remove the four M3×6 Philips panhead screws, and then disconnect CPU board radiator and industrial control board assembly from the main board;

   Note: there is a jumper cap on the industrial control board, if it is forgotten to install, then the system time will return to the default time each time you restart the system. So make sure to fix the jumper cap at the right position.

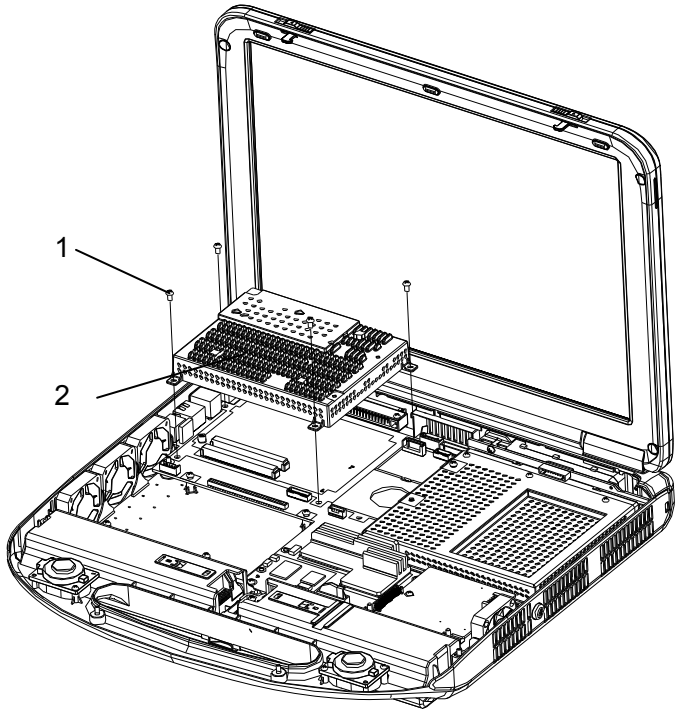


Fig 4-26 Removing CPU Board and Radiator Module

No.	Name	No.	Name
<1>	Philips panhead screw M3×6	<2>	CPU board and radiator module

3. As shown in figure below, remove the 5 M2.5×8 Philips panhead screws fixing the CPU board radiator and industrial control board, separate the CPU board radiator and industrial control board.

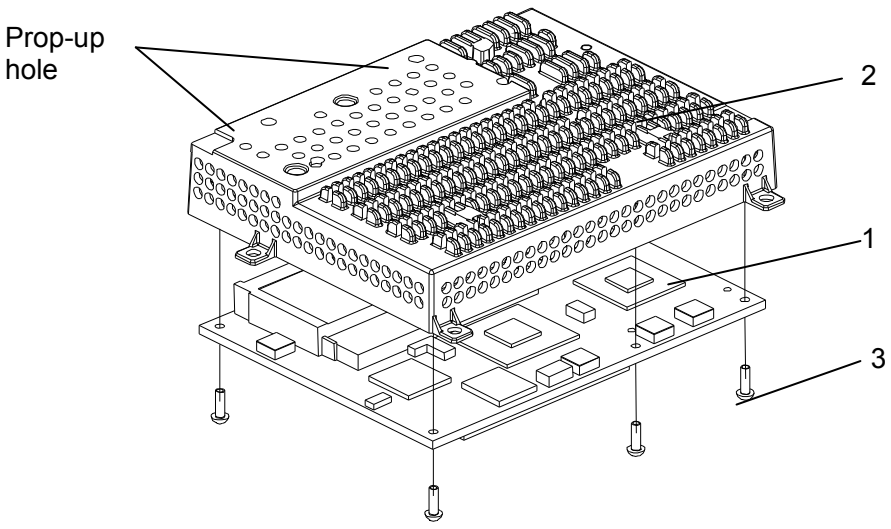


Fig 4-27 Removing CPU Board

No.	Name	No.	Name	No.	Name
<1>	CPU board and memory	<2>	Shielding cover of CPU board	<3>	Philips panhead screw M2.5×8

4.3.7.1 Removing Memory Stick

Move the buckles of the memory stick outside, the memory stick will automatically pop up, then take out the memory stick.

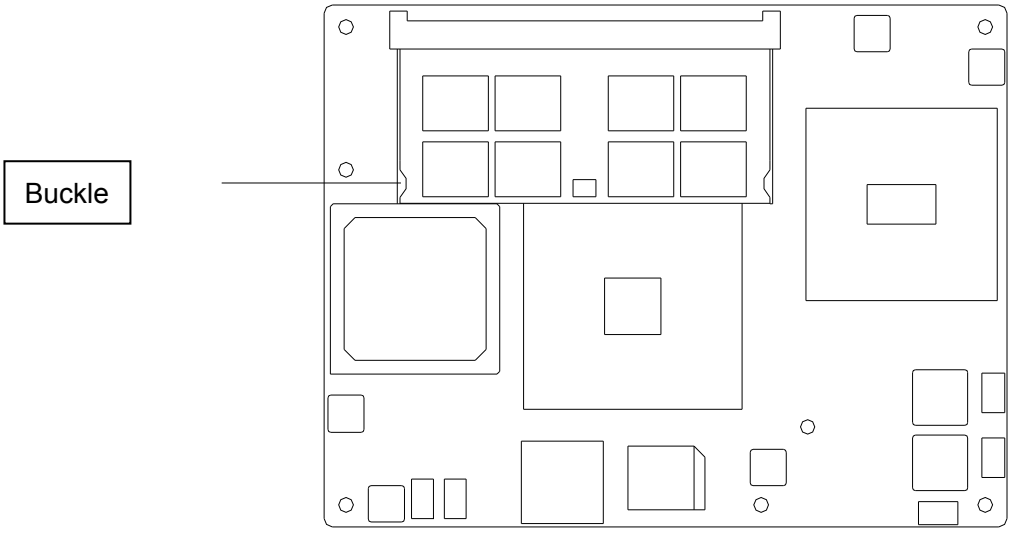


Fig 4-28 Removing the Memory Stick

4.3.8 Removing the System Fan

As shown in 4.3.3, remove the top cover assembly of main unit.

As shown in figure below, pull out connectors between the system fan, main board, and CPU fan;

Pull out the fan from the main unit bottom cover in the vertical direction.

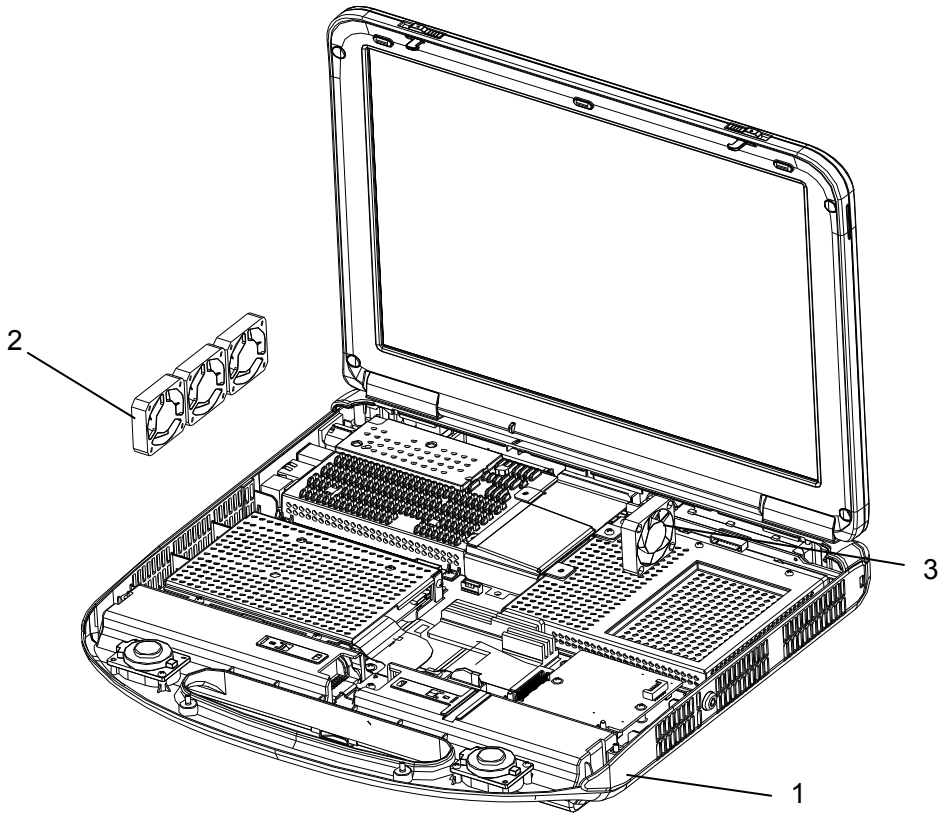


Fig 4-29 Removing CPU Fan

No.	Name	No.	Name	No.	Name
<1>	Bottom cover of main unit	<2>	Fan (3 as a group)	<3>	Fan

Note: When you reinstall the fans, note that the three system fans shall blow wind outside (the brand shall face to the outside); the single fan shall blow wind outside (the brand shall face to the inside),then verify that all fans can rotate normally.

4.3.9 Remove the Speakers

As shown in 4.3.3, remove the top cover assembly of main unit;

As shown in figure below, pull out the connector of the speaker;

Remove the four (2×2) M2.5×8 screws, and remove the speakers.

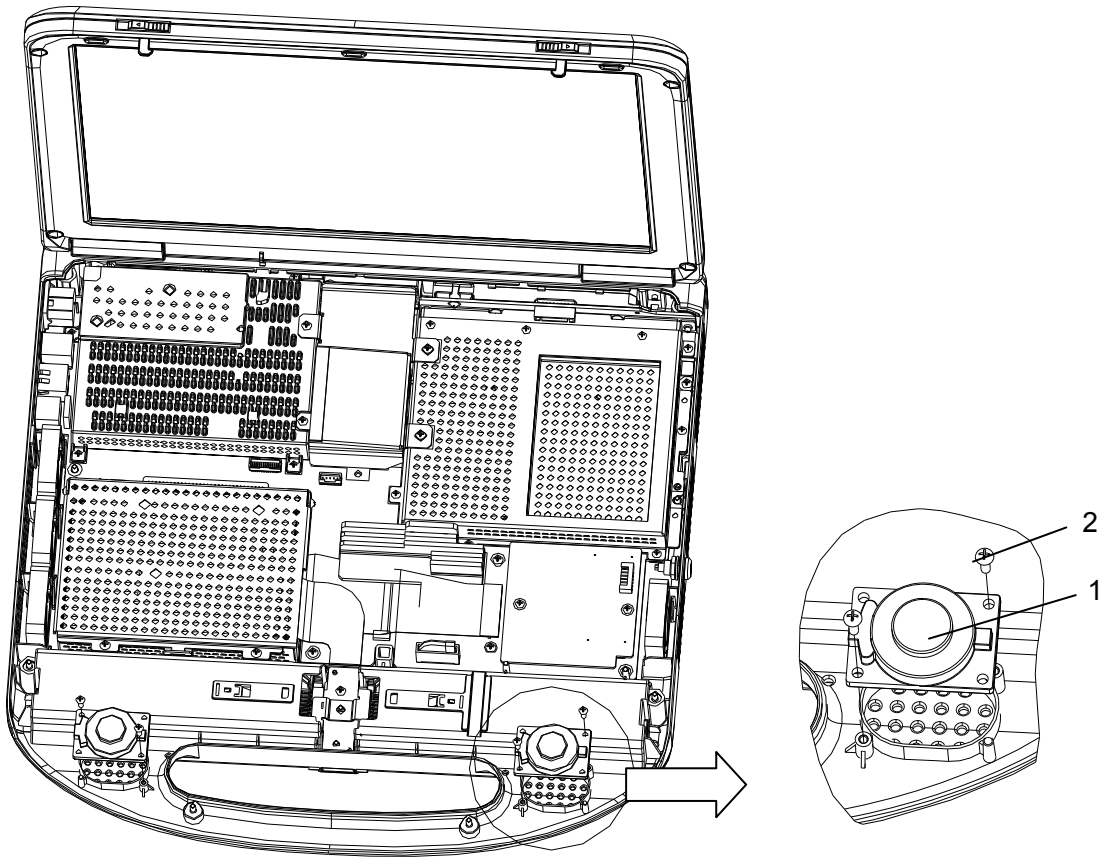


Fig 4-30 Removing the Speakers

No.	Name	No.	Name
<1>	Speaker	<2>	Philips panhead screw M2.5×8

4.3.10 Removing Transmission Board

As shown in 4.3.3, remove the top cover assembly of main unit;

As shown in figure below, remove the nine M2.5×8 Philips panhead screws;

Remove the top shield cover of the main board;

Remove the 4 screws fixing the transmission board, and disconnect the transmission board with two hands. Note that the transmission board and main board are connected by four connectors, so use force evenly.

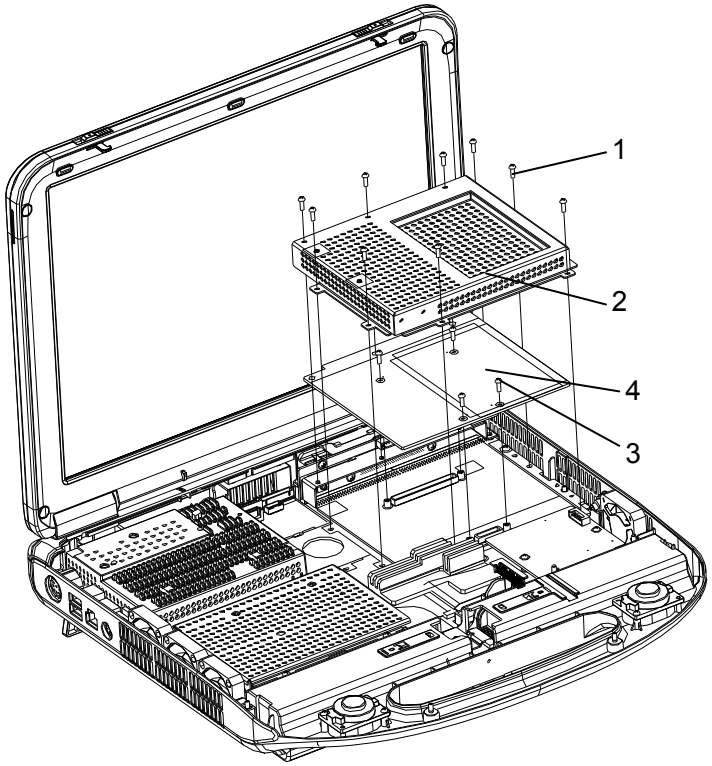


Fig 4-31 Removing Transmission Board

No.	Name	No.	Name
<1>	Philips panhead screw M2.5×8	<2>	Top shield cover of main board
<3>	Philips panhead screw M3×6	<4>	Transmission board

4.3.11 Removing Main Board and Transducer Board Assembly

Remove the M3X8 screws as shown in Fig 4-32.

As shown in 4.3.3, remove the top cover assembly of main unit;

According to steps 1) and 2) in 4.3.1, remove bottom cover cable cover, disconnect display signal cable and power cord;

According to 4.3.4, remove power module;

According to , remove CPU fan;

According to 4.3.7, remove CPU board and radiator module;

According to step 1) in 4.3.8, pull out connectors between the system an and main board;

According to step 1) in 4.3.9, pull out connectors between speaker and main board;

As shown in Fig 4-33, remove the four M3×6 screws, and tilt the main board assembly up for about 30 degrees;

Pull the main board and transducer board assembly out slightly to remove them.

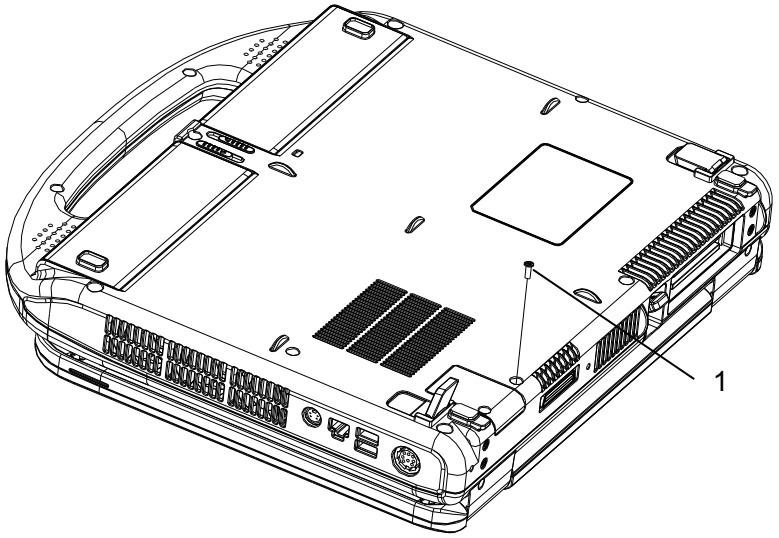


Fig 4-32 Removing the M3X8 Screw

No.	Name	No.	Name
<1>	M3×8 screw		

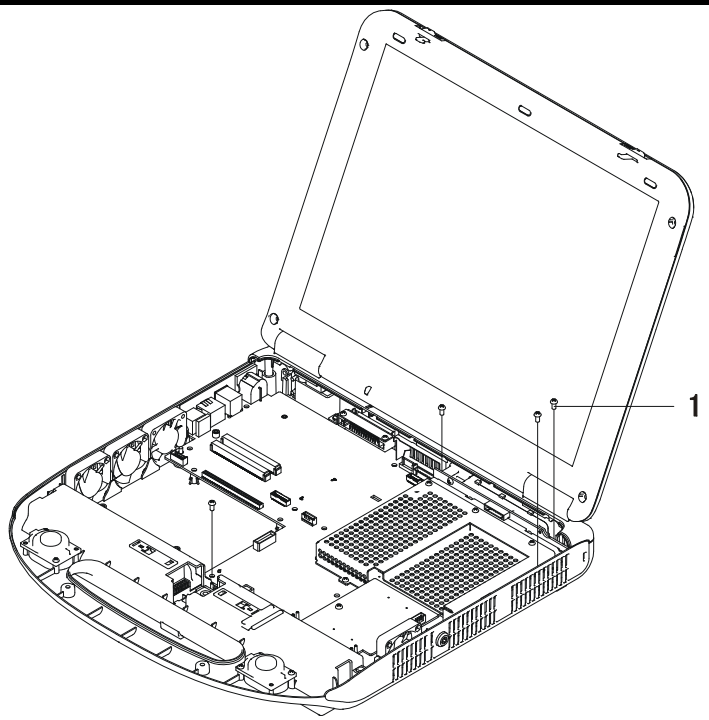


Fig 4-33 Remove the Main board and Transducer Board

No.	Name	No.	Name
<1>	Philips panhead screw M3×6		

4.3.12 Remove the Transducer Board

1. According to 4.3.11, remove the main board and transducer board;
2. As shown in figure below, remove the 9 screws fixing transmission board shield cover; then remove main board top shield cover and main board bottom shield cover.

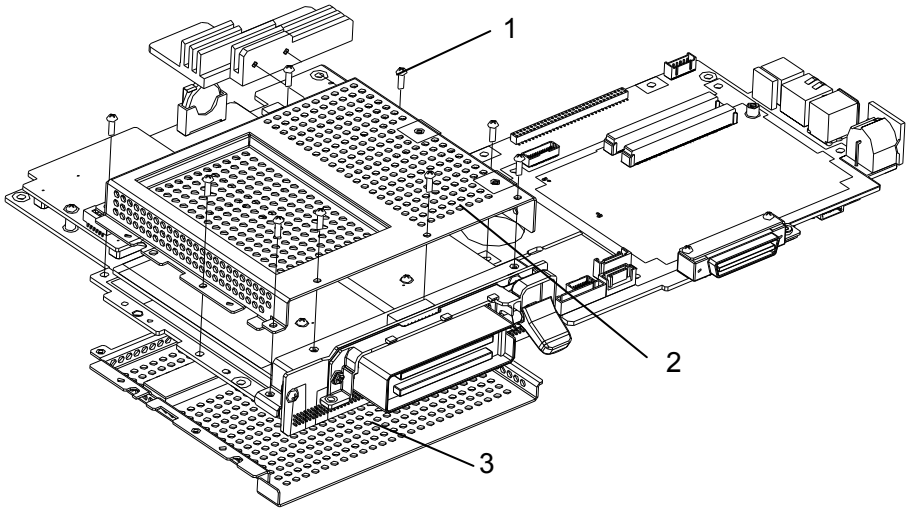


Fig 4-34 Remove the Transducer Board (1)

No.	Name	No.	Name
<1>	Philips panhead screw M2.5×8	<2>	Top shield cover of main board
<3>	Bottom shield cover of main board		

3. As shown in Fig 4-35 Remove the Transducer Board (2), pull out the transducer board from the main board with two hands, use force evenly to prevent damaging the connector pins.

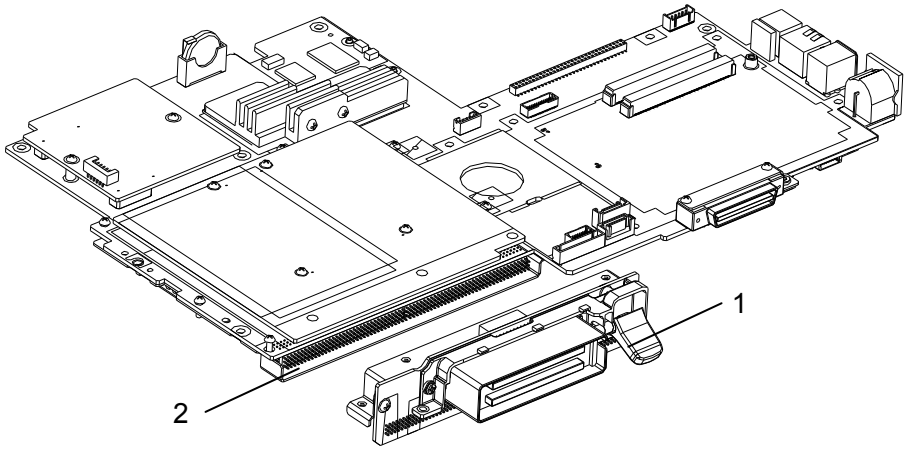


Fig 4-35 Remove the Transducer Board (2)

No.	Name	No.	Name
<1>	Transducer board assembly	<2>	The connector between main board and transducer

4.3.13 Removing 4D Board and Installation

◆ **Removing:**

1. According to 4.3.11, remove the main board and transducer board;
2. As shown in figure below, remove the 3 M2.5×8 screws, and then take out the 4D driving board.

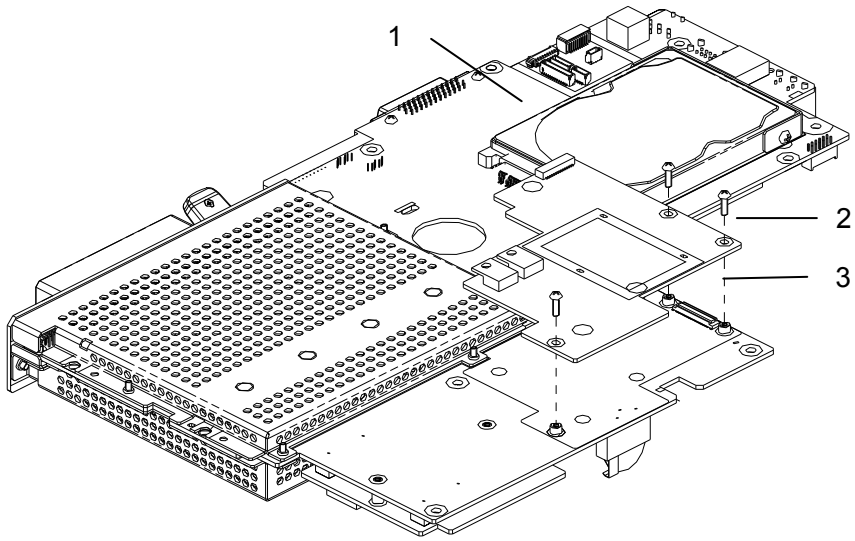


Fig 4-36 Removing 4D Board

No.	Name	No.	Name
<1>	Main board assembly	<2>	Philips panhead screw M2.5×8
<3>	4D Driving Board		

◆ Installation:

1、Affix the 4D heat outlet washer in the bottom board of the main unit cover as shown in figure 4-37.

2、Plug the 4D board PCBA to the main board, fix the board with 3 M2.5X8 cross panhead screws, as shown in figure 4-38.

3、Install the cable:

A. Plug one end of the 4D signal line to the 4D board PCBA socket, and affix the cables tightly with fiber tape, as shown in figure 4-39.

B. Plug the other end of the 4D signal line to the probe board socket across the hole in the main board, and fix the cable using fiber cape and cable tie, as shown in figure 4-40.

4、Install the mother board and probe board assembly into the main unit cover.

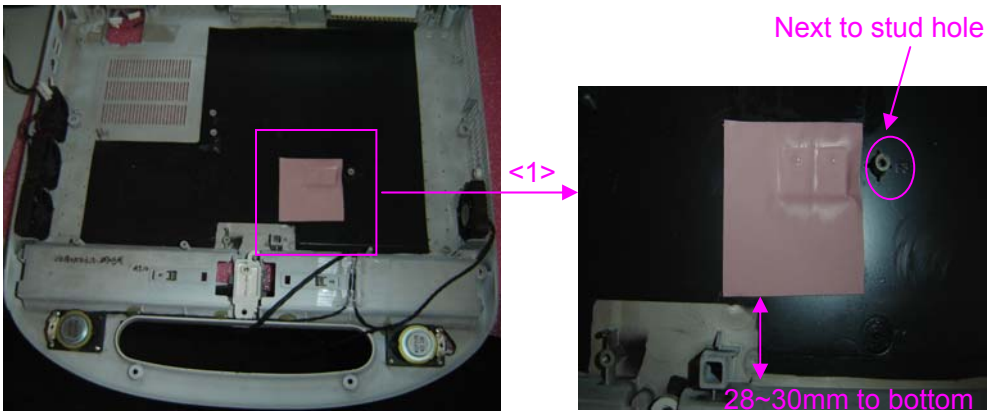


Figure 4-38

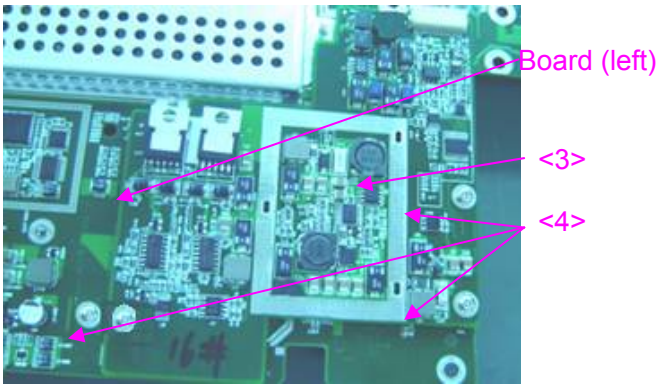


Figure 4-39

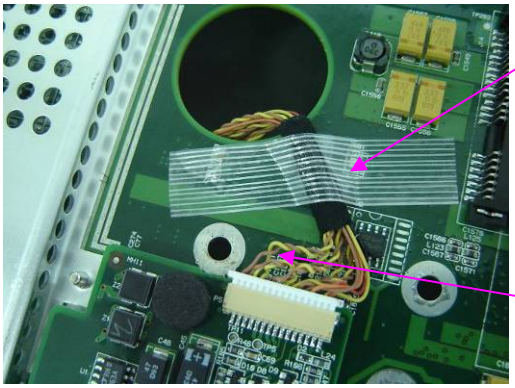


Figure 4-40

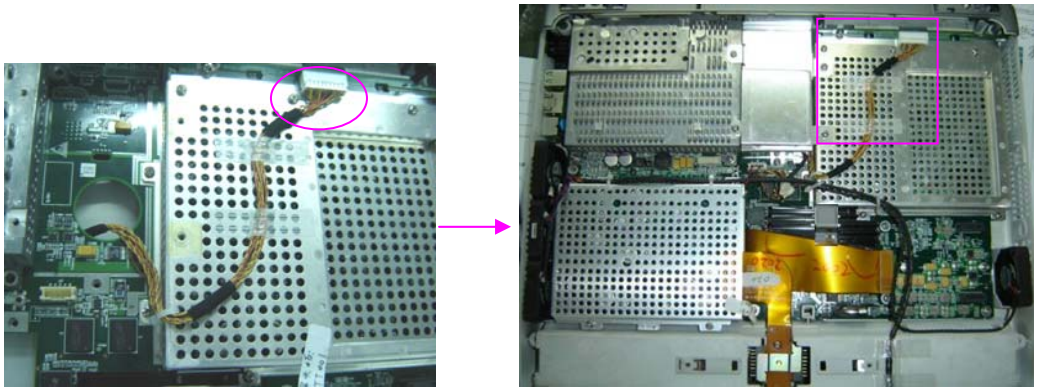


Figure 4-41

Serial No.	Name	No.	Serial No.	Name	No.
<1>	*4D heat outlet washer* *045-000164-00*	*1*	<2>	*4D signal line* *009-000188-00*	*1*
<3>	*4D board PCBA* *051-000102-01*	*1*	<4>	Philips panhead screw *M2.5×8* *M04-051121---*	*3*

⚠Caution: Use screw driver to manually screw the M2.5 screw tightly and appropriately, be careful not to damage the board.

Note:
1. Discard the films at the both sides of the 4D heat outlet washer.
2. Press and hold the left board as in figure 2 when screwing the 4D board PCBA screws.
3. Use adhesive tape to affix the 4D signal line, or other insulting tapes.

4.3.14 Removing Hard Disk

NOTE please pay attention to the following matters during disassembling/assembling, otherwise the hard disk will be damaged:

- Hold the side of the hard disk, and please do not touch the board of the hard disk.
- Fasten the screws with the handy screw driver, and do not with the electric screw driver.
- The torsion value of the screw lock is:

  M3: 4 to 6 kgf.cm

  M4: 6 to 8 kgf.cm

1. According to 4.3.11, remove the main board and transducer board;
2. Shown as figure below, remove the M3×6 screws, horizontally pull out the HDD and HDD fixing part, then remove the four M3×4 screws.

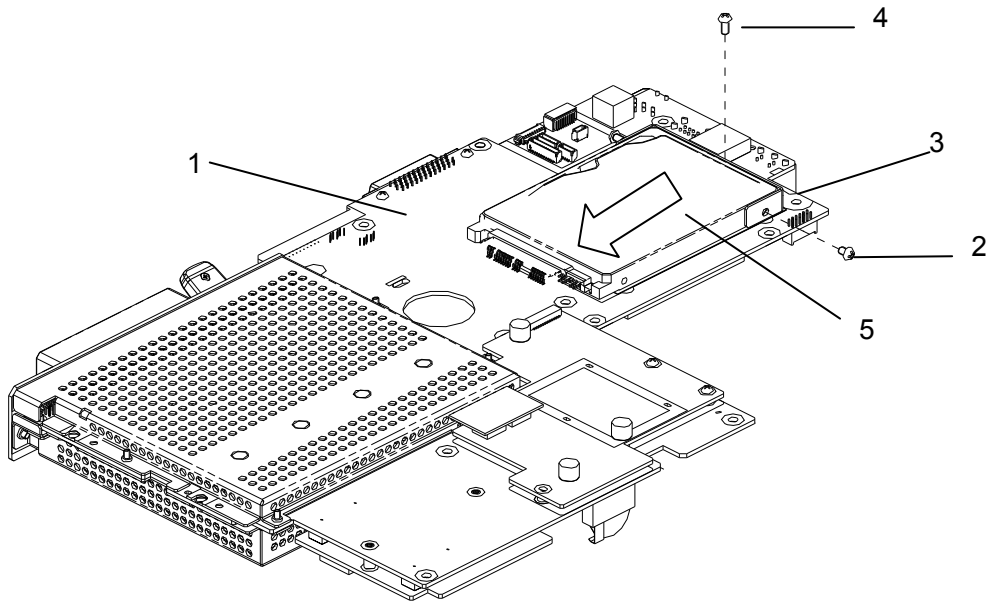


Fig 4-42 Removing the HDD

No.	Name	No.	Name
<1>	Main board assembly	<2>	Philips panhead screw M3×4
<3>	Philips panhead screw M3×6	<4>	HDD fixing part,
<5>	Hard disk		

4.3.15 Removing Transducer Extend Module PEM-11

1. Remove four M3×6 Philips panhead screws, and then remove the fixing board of the transducer extend module.
2. Remove four M3×6 Philips panhead screws, then remove the bottom cover of the transducer extend module.

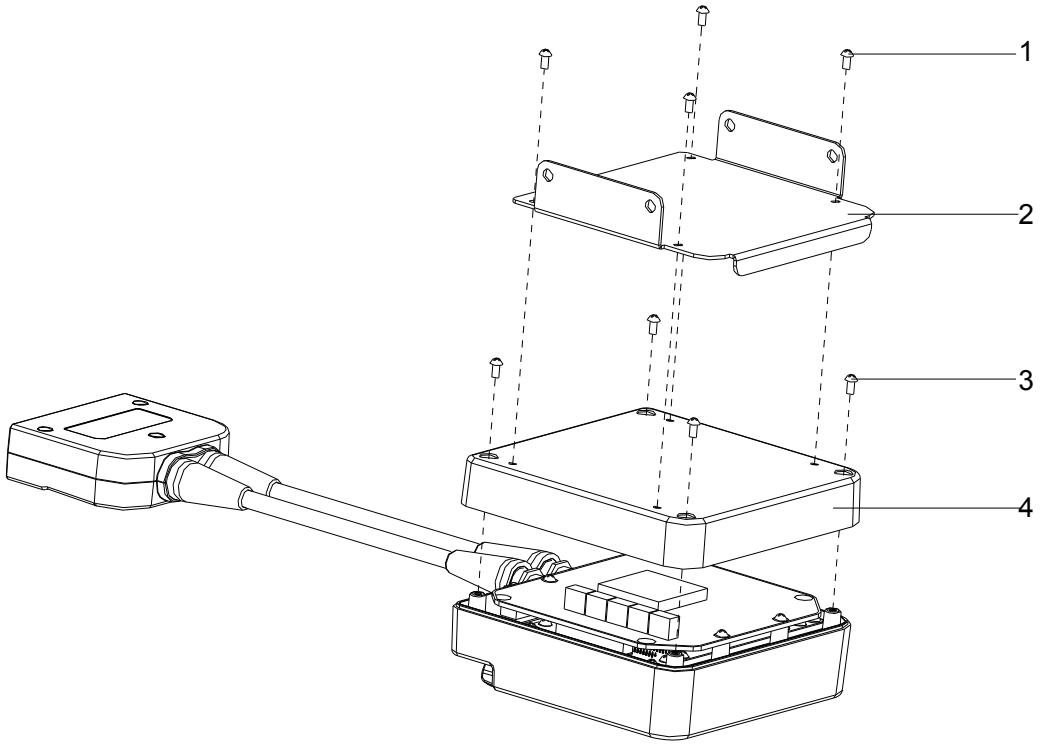


Fig 4-43 Remove the Transducer Extend Module (1)

3. Remove three M3×6 Philips panhead screws.
4. Pull out B transducer extend board vertically upward, and separate it from socket on the A transducer extend board.
5. Disconnect the connective board on the transducer extend module socket of the B transducer extend board, and remove B transducer extend board.
6. Hold the transducer wire sheath and pull it out vertically, and remove the extend module socket.

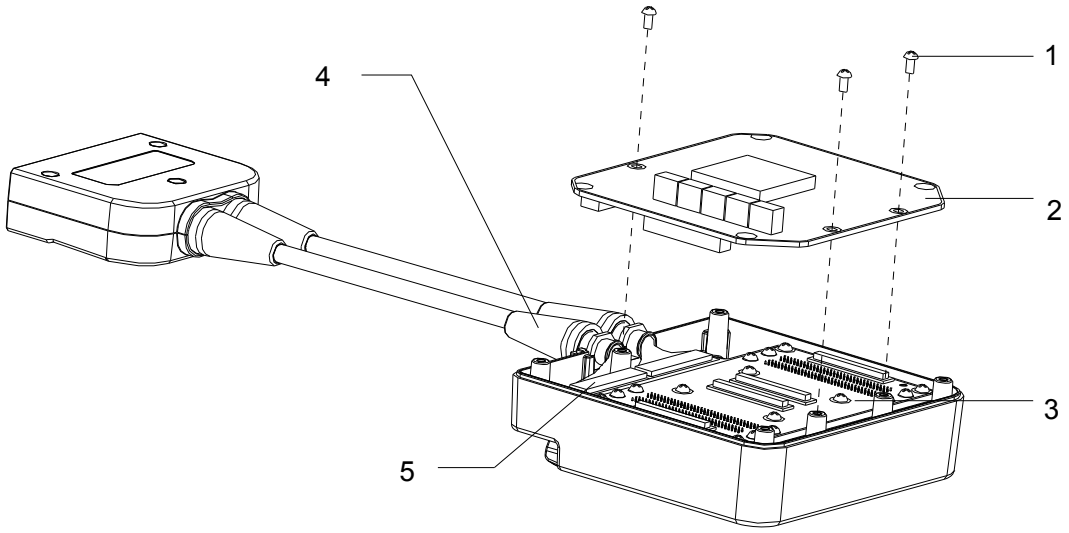


Fig 4-44 Remove the Transducer Extend Module (2)

7. Remove two M2×4 Philips sunk screws, and pull out the transducer lever.

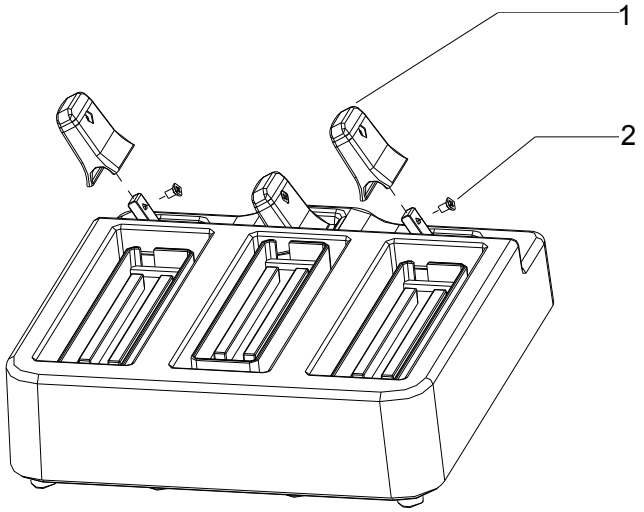


Fig 4-45 Remove the Transducer Extend Module (3)

No.	Name	No.	Name
<1>	Transducer lever	<2>	Philips sunk screws M2×4

8. Remove the 8 M3×6Philips panhead screws, and carefully pull out the A transducer extend board.

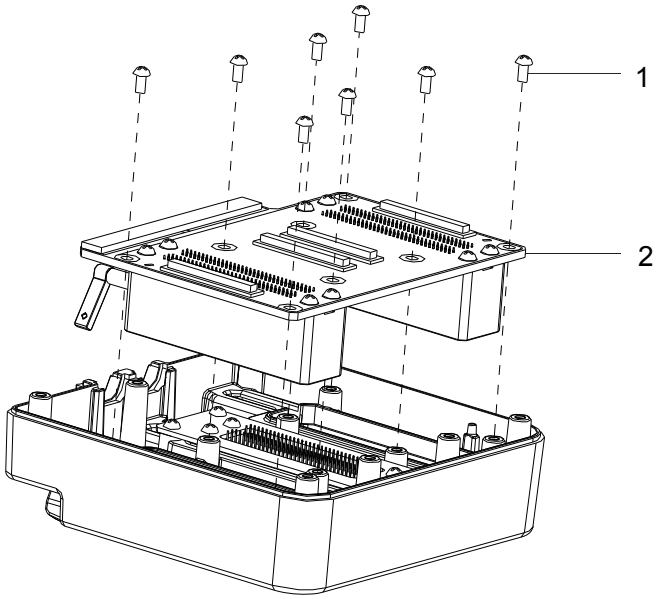


Fig 4-46 Remove the Transducer Extend Module (4)

No.	Name	No.	Name
<1>	Philips sunk screws M3×6	<2>	A transducer extend board

9. As shown in step 7), remove the transducer lever.

10. Remove the 8 M3×6 Philips panhead screws, remove the female base of transducer socket.

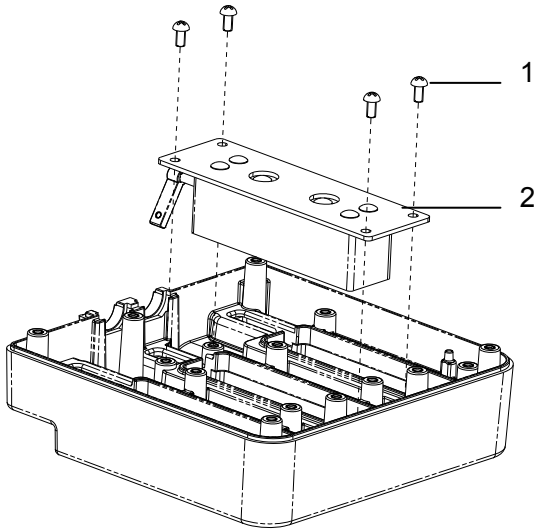


Fig 4-47 Remove the Transducer Extend Module (5)

No.	Name	No.	Name
<1>	Philips panhead screw M3×6	<2>	Transducer bracket

Note: PEM-21 transducer extend module should be applied with UMT－300 mobile trolley, for disassembling UMT－300, please refer to the corresponding service manual.

4.3.16 Removing ECG Module

1. Use tweezers to take out the four connector enclosure screw caps (take care not to scratch the enclosure), remove the four M3X8 screws, and remove ECG module top cover.

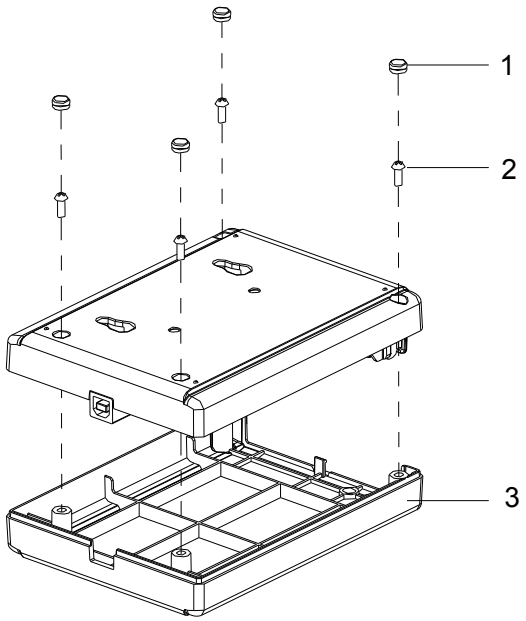


Fig 4-48 Remove the ECG Module (1)

No.	Name	No.	Name
<1>	Screw cap	<2>	Screw M3X8
<3>	Top cover of ECG module		

2. Remove the two M3X8 screws, disconnect connector of the ECG module internal signal cable, and then remove the ECG board.

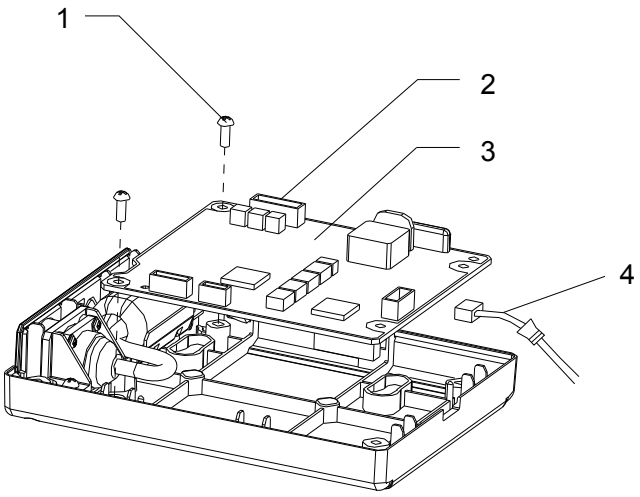


Fig 4-49 Remove the ECG Module (2)

No.	Name	No.	Name
<1>	Screw M3X8	<2>	Socket
<3>	ECG board PCBA	<4>	ECG serial cable

3. Remove the four M2X8 Philips panhead tapping screws and flat washers. Cut off the two wire strips on the magnetic ring, and remove the internal signal cable of ECG module.

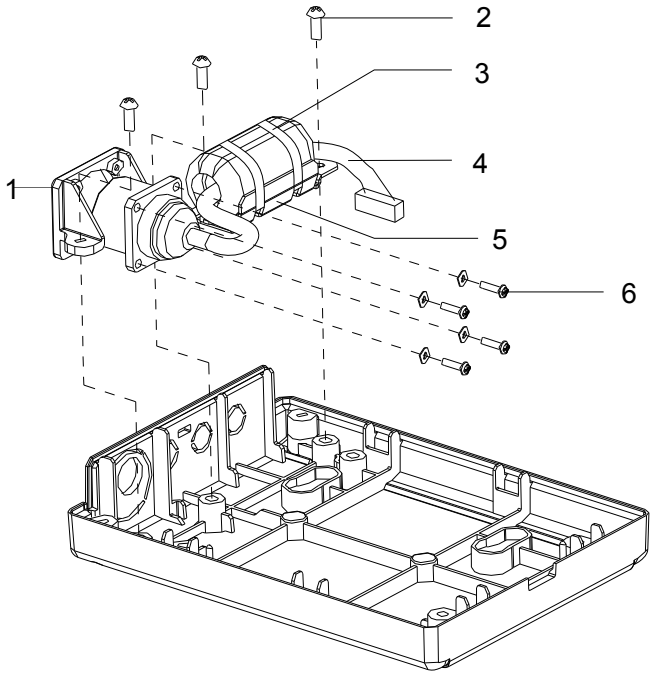


Fig 4-50 Remove the ECG Module (3)

No.	Name	No.	Name
1	ECG socket fixing part	2	Screw M3X8
3	Cable tie	4	ECG internal signal cable
5	Magnetic ring fixing part	6	Philips panhead tapping screw M2X8 and flat washer

4.3.17 Removing Video and Audio Capture Module

1. Use tweezers to take out the four connector enclosure screw caps (take care not to scratch the enclosure), remove the four M3X8 screws, and then remove the top cover.
2. Remove the three M3X8 screws fixing the video and audio capture card, and remove video and audio capture card.

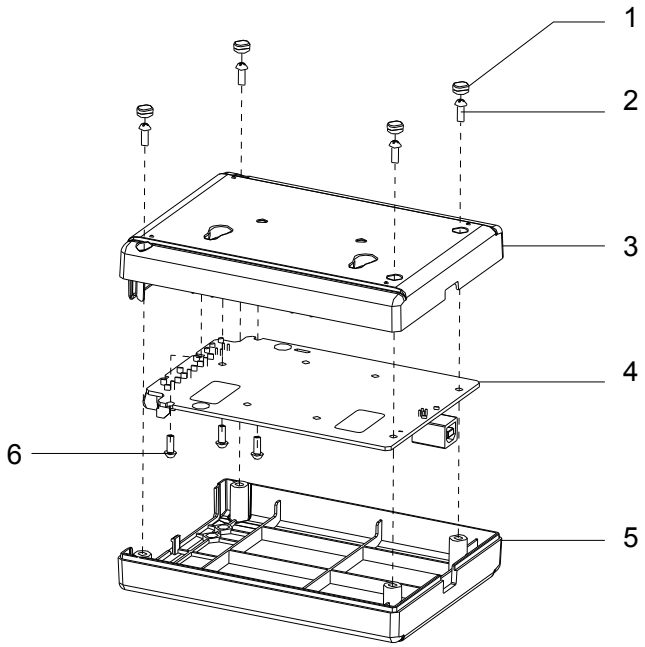


Fig 4-51 Removing Video and Audio Capture Module

No.	Name	No.	Name
1	Screw cap	2	Screw M3X8
3	Top cover	4	Video/ audio capture card
5	Bottom cover	6	Screw M3X8

4.3.18 Removing I/O Extend Module

Remove the five M3X8 screws, and separate the I/O extend module.

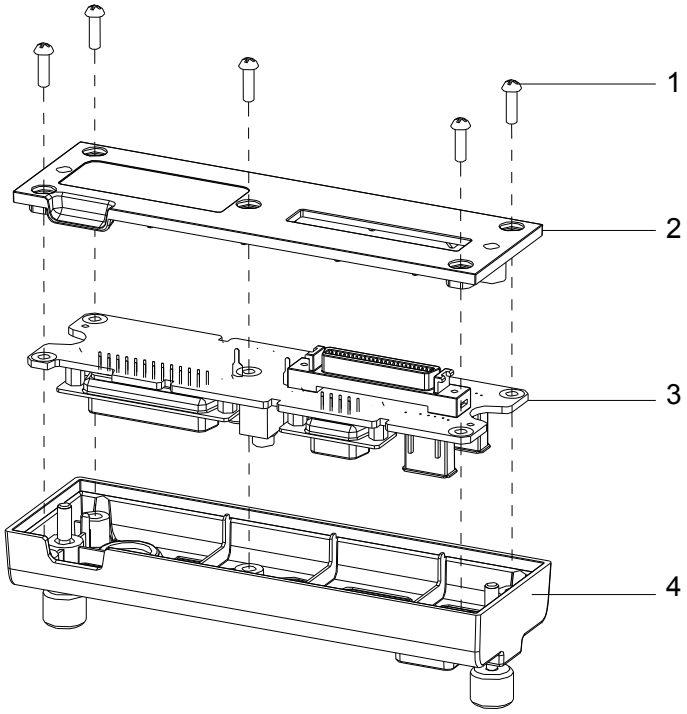


Fig 4-52 Remove the I/O Extend Module

No.	Name	No.	Name
	Screw M3X8		Back cover
	IO extend board		Front cover

5 System and Software

5.1 XPE System Introduction

The full name of XPE is Windows™ XP Embedded, it is the embedded system for Windows™ XP of Microsoft® company. It is not a dedicated embedded operation system, but providing a tool for development and deployment. XPE can be used to define and edit the standard Windows XP, and some embedded application features and units are added to it.

For M7, after the XP operation system, the following drivers and functions are automatically installed:

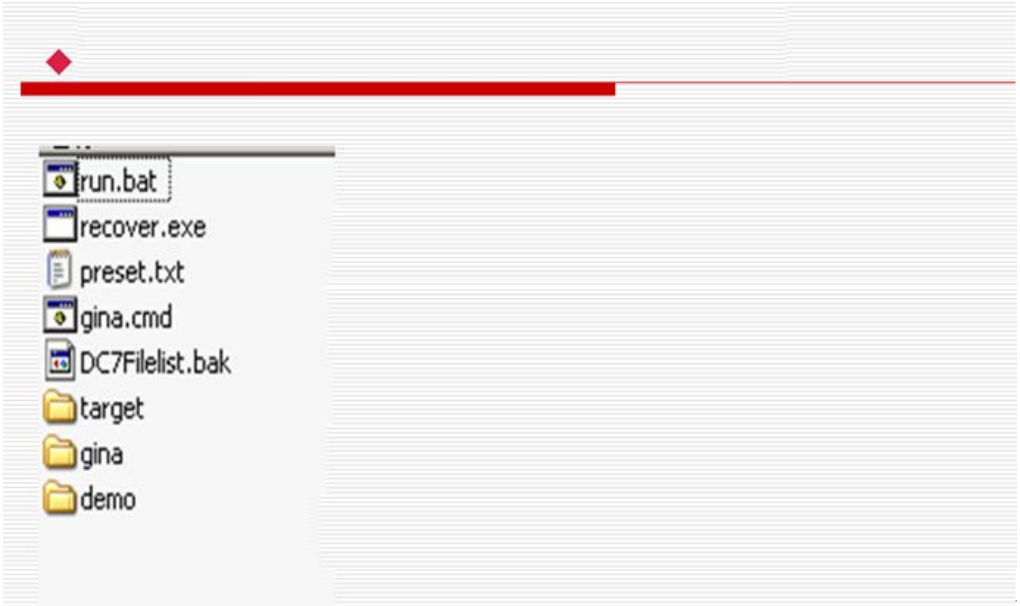
Table 5-1 Functions defined by XP operation system

Install the main board driver: chip group, video card, audio card, and network card.
Install the video printer driver: SONY UP-D23MD driver, SONY UP-D897 driver, and MITSUBISHI P93D driver.
Install digital printer: HP Deskjet 2568, HP Office 3600, and HP 1015
USB video capturing box driver
USB Footswitch
Install CPU temperature and fan monitoring service
Hardware self-test program running environment
Keyboard filter driver
Install east Asia language: set the language and region as Chinese (PRC)
Install the desktop theme: M7.Theme, no voice.
Power on/Power off/login define
WINDOWS boot-up interface setting
No Autorun or autoplay
No screen saver

Shut down functions like the fire wall and automatic updating.

5.2 Introduction of Doppler

5.2.1 Resume Package



run.bat: run the batch file

recover.exe: recover file

preset.txt: preset data default regulatory type control file

gina and gina.cmd: define the boot-up progress bar

demo: demo data

DC7Filelist.bak: recover data list.

Fig 5-1 Structure of the resume package

Note：	Resume package should be compatible with the machine type, that human package be resumed on human machine, vet use package be resumed on vet machine.

5.2.2 Data Processing

After the resume package is activated, the data structure and storage destination are listed as follows:

Table 5-2 Data processing

Type	File suffix	Signal definition of testing points	Destination
Data in the hard disk	APD	Compress the update files and check if there are same directory data in the hard disk, if yes, then delete the old directory data, and then create new directory number.	C:\M7\app
	EXD		C:\M7\exe
	GPD		C:\M7\fpga
	VDD		C:\M7\video
	GUD		C:\M7\gui
	IMD		C:\M7\Image
	PST		C:\M7\Preset
	FKY		C:\M7\Key
	PCD	Decompress the update files and check if there are same directory data in the hard disk, if yes, delete it and create new directory data, and then configure the Windows desktop.	C:\M7\config, C:\WINDOWS\boot.bmp
Demo		Copy the Demo data in the resume package to the target directory	E:\M7\Demo
Drive	DRD	Including DSP drive, multifunctional board drive, USB keyboard drive, Smbus drive, decompress the update files to the temporary directory in the hard disk, and install the drives respectively, then delete the temporary directories when finished the installation.	Installed the corresponding drives C:\windows\system32\
FPGA	FPD	Including DSP FPGA, multifunctional FPGA, beam former FPGA, transmitting FPGA, decompress the update files to the temporary directory of the hard disk, and write data in their configured flash through the corresponding drive program. Delete the temporary directory when finished.	The corresponding configurations of the logic flash
Keyboard	KUG	Analyze the update files and cache the keyboard data into buffer, and then check keyboard communication, and E/W keyboard flash.	Keyboard board

Type	File suffix	Signal definition of testing points	Destination
ECG	ECG	Analyze the update files and save the ECG data into buffer, and then check ECG module communication, and E/WECG flash.	ECG module
Power monitor	ARM	Analyze the update files and decompress the ARM data into the temporary directory of the hard disk, check the ARM communication and E/W, delete the temporary directories when finished.	Power monitor module

5.3 Run the Resume Package in Doppler

NOTE:
1. Before executing the resume package, please back up the patient data as well as the user-defined preset data.
2. If the resume is performed with a disk in Doppler, then the disk inserted can't be recognized when the ultrasound machine is running, in this case, please shut down the system first, then insert the disk, and then restart the system. The disk can be recognized, and resume can be performed.

Operation procedures:

1. Copy the resume package to the USB disk;
2. After system boot-up, login as service engineer;
3. Press <Setup> to open the Setup menu, select [Maintenance] to open the Maintenance menu.
4. Select [Enter Windows], and you can see all the drive letters;
5. Found the run.bat file in the USB disk, and double click it. The following information appears:
   SUCCESS: The process "appmon.exe" with PID XXXX has been terminated.
   SUCCESS: The process "doppler.exe" with PID XXXX has been terminated
   Press any key to continue…
   Press any key to continue, and the recovery operation will be processed automatically.
6. During the recovery, the system prompts "Do you want to delete user preset data? (Y/N)", input "Y" (note: you must select "Y", because it is possible that the preset data may not be compatible, the new preset data have to be used.)
7. After the recovery is completed, the system prompts "Press any key to continue…", inspect if all the items have been finished successfully, and press <Enter> according to the prompt, the DOS window will be closed automatically.
8. Now, delete the PATIENTDATA file in the path D:/M7/PATIENTDATA (as the patient data have been backed up already);
9. Shut down the system and then reboot the system;
10. Check the version, which should be consistent with that of the newly updated.

NOTE: After the system is restored, please check if the system model and regulation type are correct (the same as before restoration)

5.4 Power ON Process

The power ON process will last for 20 seconds, refer to the table below for the details.

Table 5-3 Power ON process

Step	Operation	Increments	Step	The possible causes when initialization dead
No prompt	Initialize Windows; Appmon initialize Doppler; Bind the path of the configuration files; Set Windows properties; Initialize the display devices, the main window, sound, USB devices agency; Activate bus devices BackboneDev and LPC; Initialize time and multi-lingual process functions; Initialize peripheral file system, network, drive, enumerate peripheral device port; Configure the timers, initialize the soft interruption, construct maintenance server, configure system static data; Configure system fonts; Load layout information; Initialize UI manager and UI graph libraries.	In increments of 7.	Configure the hardware and XPE system	Pull out the CD/DVD drive if any
Initializing hardware…	Load-on the boot-strap bitmap, display the progress bar (7), decompress the configured factory data		Boot-strap bitmap	/
Loading system preset…	Create local preset and system preset server	In increments of 1.	Configure preset data	May be the preset data is not compatible, delete the preset data
Loading common exam preset…	Create exam mode general data manager	In increments of 1.		
Loading exam	Create measure preset, peripheral devices and network, image KMP package, network	In increments		

Step	Operation	Increments	Step	The possible causes when initialization dead
preset...	storage preset servers.	of 4.		
Initializing local…	Set the region related information, the language, font library, entry method; Create control “factory”; Construct GUI layer; Set the menus; Initialize function libraries; Create UICenter	In increments of 1.	Configure HDD data	/
Initializing gui…	Construct the application layer; Initialize keyboard board; Construct the access management, remote desktop management	In increments of 1.	Pay attention to the keyboard	/
Initializing ultrasound peripheral…	Configure the file dialog box; Initialize print library; Battery monitor, 2118 system monitor; Load-on print task icon; Construct low consumption; Construct USB manager and record manager; Initialize video replay devices	In increments of 1.	Configure peripheral device, pay attention to the battery	Occasional system crash was found, not resolved yet.
Initializing ultrasound image…	Create ECG debt collection thread; Set virtual machine, initialize the virtual machine; Create front-end/back-end object tree (ultrasys, etc.)	In increments of 2.	Pod data	Occasional system crash, not resolved yet
Initializing ultrasound application…	Add measure menu functional package; Register measure patient application interface	In increments of 1.	Patient Info	/
Initialization completed…	Construct patient info manager (UPatientApp)	In increments of 1.		/
Hide the boot-strap bitmap	/	/	/	Including operation on the LCD, may lead to

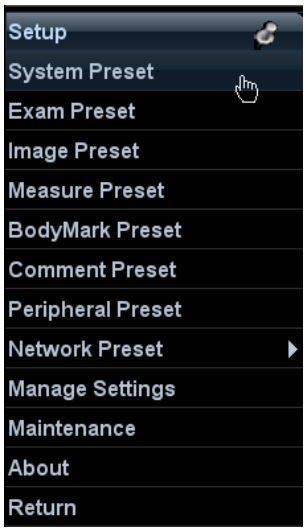
Step	Operation	Increments	Step	The possible causes when initialization dead
				system crash

5.5 Software Maintenance

Before performing the software maintenance, ensure the data used matches with the model.

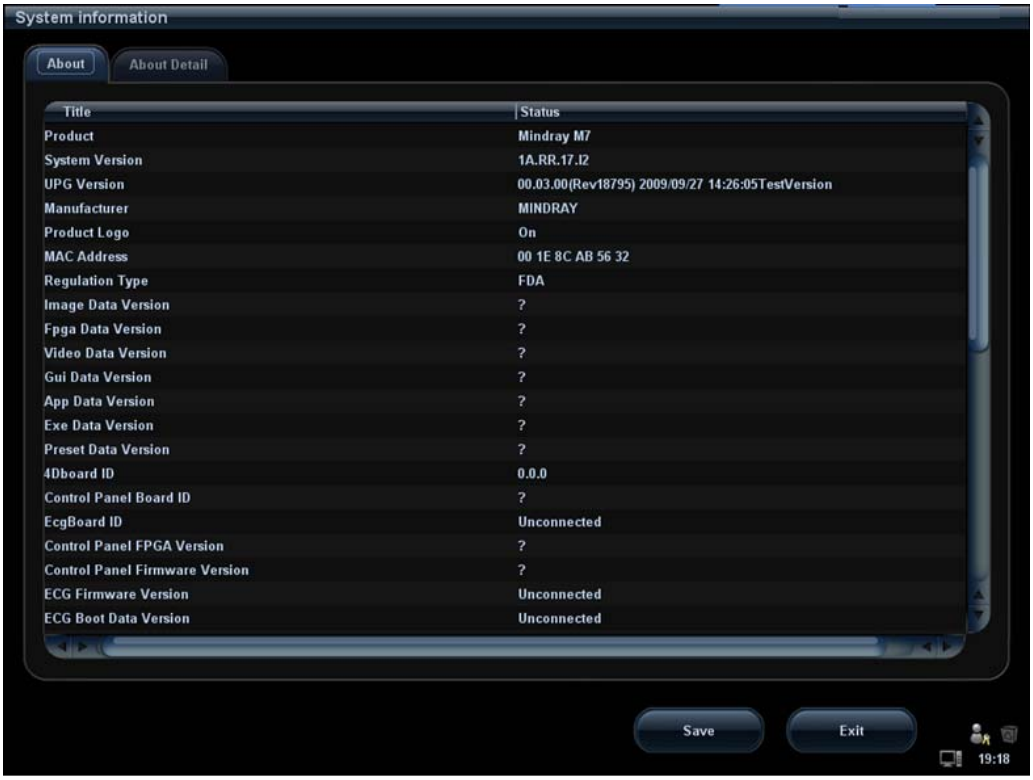
5.5.1 Entering Preset

Press <Setup> key, pops up the preset menu.



5.5.2 Viewing System Information

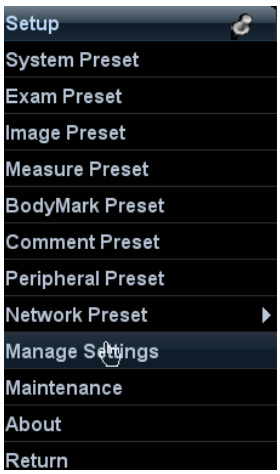
In the Setup menu, select [About], and the system information dialog box appears.



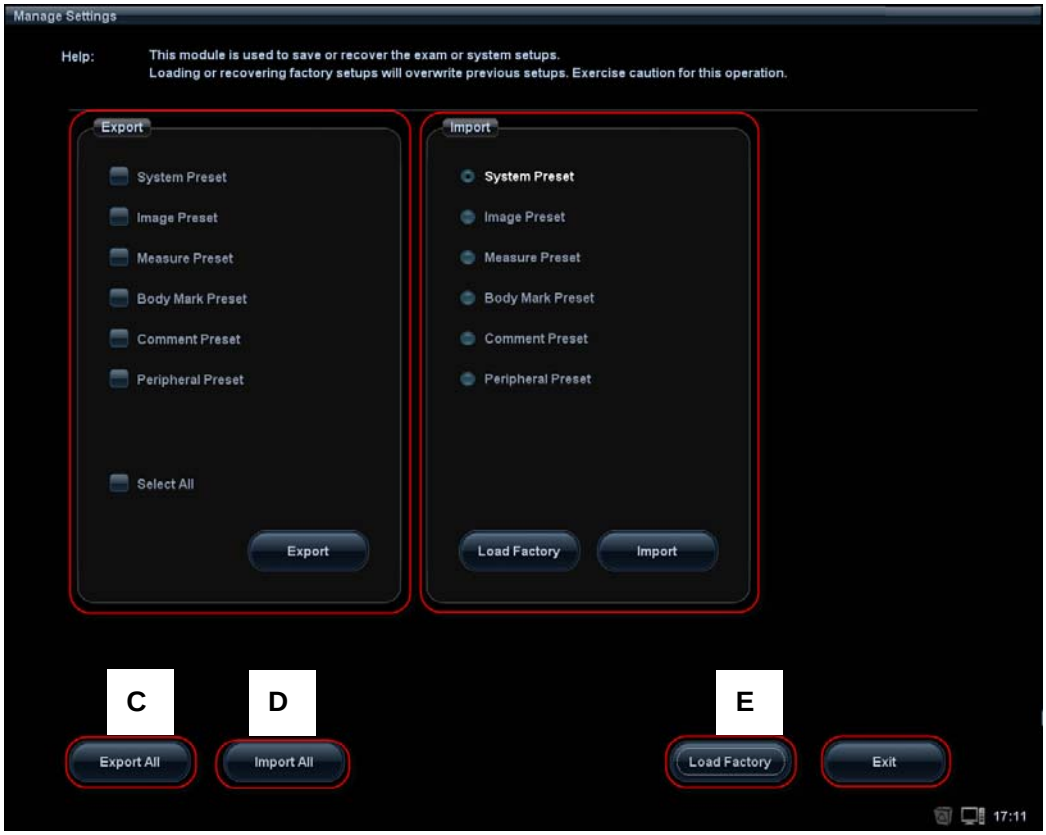
Be sure to confirm the system information before and after the software maintenance.

5.5.3 Manage Settings

1. Press <Setup> key to enter into the preset status.
2. Move the cursor onto [Manage Settings] and press [Set].



3. Select Export (Import or Restore factory) as required.



Tips:

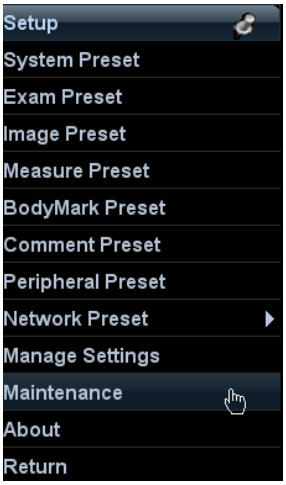
Code in Figure	Function Description
A	Export the selected presets, and save them in different files
B	Import the preset parameters, or recover the factory settings
C	Export all preset parameters, and save them in a file
D	Import all preset data at one time
E	Recover factory settings for all preset data

5.5.4 Maintenance Status

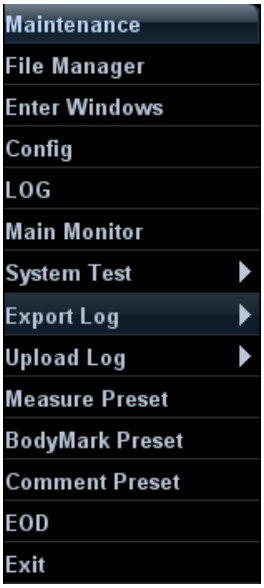
Copy the files to be used into a USB flash drive. Then insert the USB flash drive into the USB port on the main unit.

1. Enter the Preset menu.
2. Select “Maintenance”.

Note: to enter the Maintenance menu, please login the system with the user name of Service.

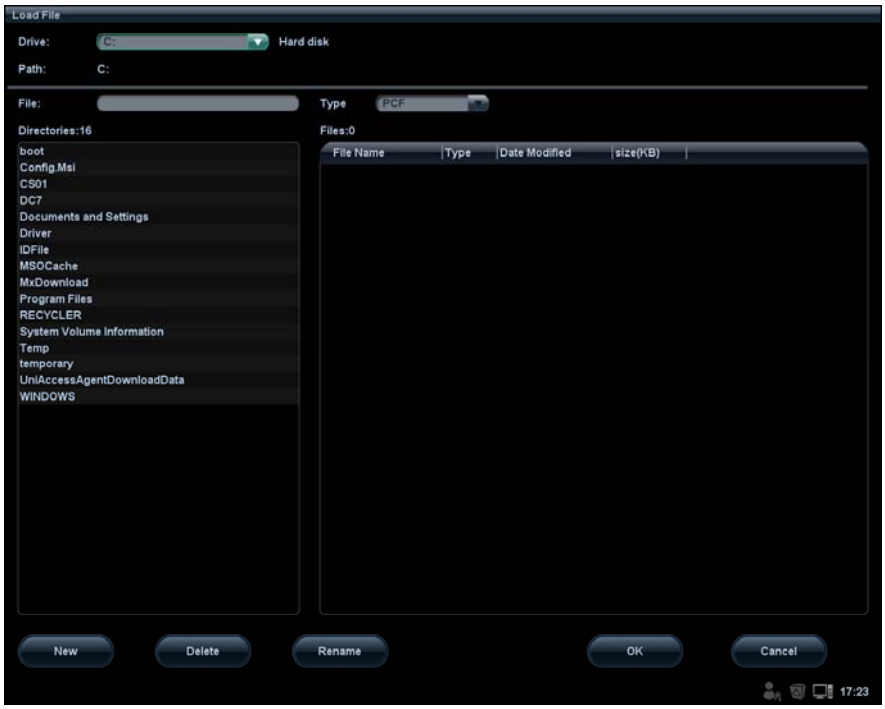


3. Select “Maintenance”



5.5.5 Model Setup

1. Enter into maintenance status. Select “Config”, and press <Set>.Enter into the Config menu:

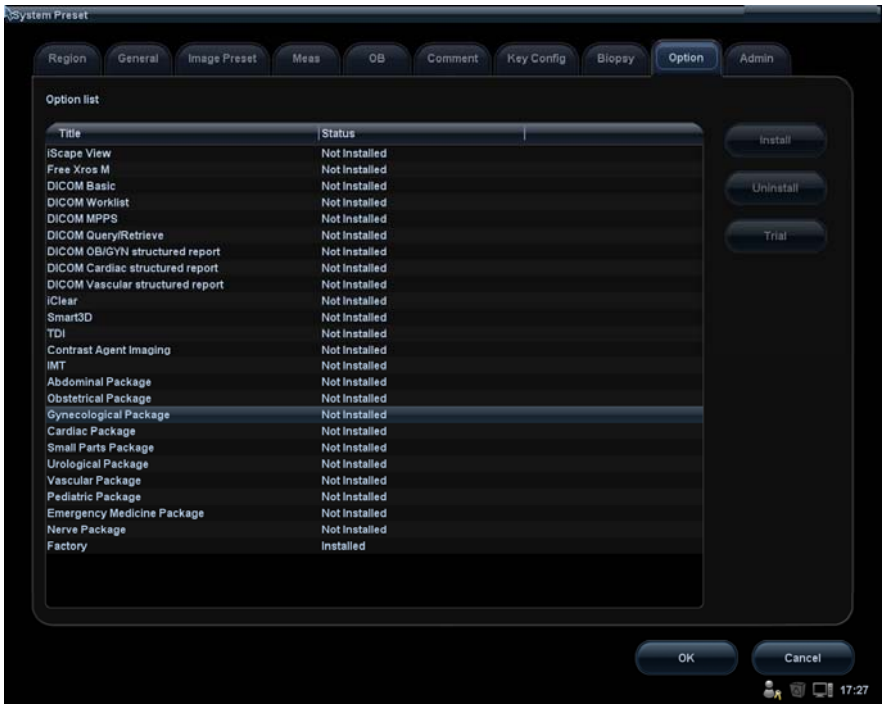


2. Select the correct files, and click [OK]. After the operation is completed, the successful prompt appears. Restart the system according to the prompt.

Note: the default configuration is that of M7, and it is already finished during the resume package configuration. For M7T, the product information has to be configured according to the configuration files.

5.5.6 Installing Optional Software

1. Enter the Setup menu.
2. Click [System] on the Setup menu to open the System Preset screen.
3. In the System Preset dialog box, select [Option] to open the dialogue box shown in the figure below.



4. In the optional list, select the desire software function, and click “Install”.
5. In the opened dialog box, select the corresponding key file, and click [OK].

The key file is corresponded to the system one by one, and you can copy it to the flash drive, and install through the flash drive;

6. After the installation is completed, return to the system setup screen, and the corresponding options shall be in the installed status. Click [OK] to close the System Preset dialog box.

Note:

1. The key file needed for software installation is copied in the system accompanying CD.

2. After ultrasound software recovery, the optional software should be reinstalled.

5.6 Warning

If malfunctions appeared during the system operation, the ultrasound machine M7 will give out warnings, or generate LOGs which will be saved in system logs, the logs is saved in the path: D:\M7\Log\Perilog.

5.6.1 Battery warning

5.6.1.1 Battery Connect & Disconnect

Operation	Warning	LOG
Left battery hot plug	“Warning! Invalid battery operation！ May lead to battery damage”	“2009-9-7,2:43:11 U2118Monitor: Left Battery Hot Plug”
Right battery hot plug	“Warning! Invalid battery operation! May lead to battery damage”	“2009-9-7,2:43:11 U2118Monitor: Right Battery Hot Plug”
Left battery hot insert	None	“2009-9-7,2:43:11 U2118Monitor: Left Battery Hot Insert”
Right battery hot insert	None	“2009-9-7,2:43:11 U2118Monitor: Right Battery Hot Insert”
Left Battery Hot Plug, Shutdown State	None	“2009-9-11,2:43:11 U2118Monitor: Left Battery Hot Plug, Shutdown State”
Right Battery Hot Plug, Shutdown State	None	“2009-9-11,2:43:11 U2118Monitor: Right Battery Hot Plug, Shutdown State”

5.6.1.2 Battery I2C Exception

Operation	Warning	LOG
Adapter power supply, light battery I2C exception	Left battery communication I2C error, battery capacity can’t correctly displayed, or current battery can’t be used	“2009-9-7,2:55:11 U2118Monitor: Left Battery Communication I2C error”
Adapter power supply, right battery I2C exception	Right battery communication I2C error, battery capacity can’t correctly displayed, or current battery can’t be used	“2009-9-7,2:55:18 U2118Monitor: Right Battery Communication I2C error”
Battery power supply, left battery I2C exception<	Left battery communication I2C error, please insert the adapter or power off the system, otherwise, the system will be shut down after XX seconds!	“2009-9-7,3:11:13 U2118Monitor: Left Battery Communication I2C error”

Battery power supply, Right battery I2C exception<	Right battery communication I2C error, please insert the adapter or power off the system, otherwise, the system will be shut down after XX seconds!	“2009-9-7,3:11:19 U2118Monitor: Right Battery Communication I2C error”
Left Battery I2C Exception, Shutdown State	None	“2009-9-11,3:11:19 U2118Monitor: Left Battery I2C Exception, Shutdown State”
Right battery I2C exception, Shutdown state	None	“2009-9-11,3:11:19 U2118Monitor: Right Battery I2C Exception, Shutdown State”

5.6.1.3 Battery Cycle Count beyond the Limitation

Operation	Warning	Log
Left battery cycle count is beyond the limitation	Battery life will do, replace it as soon as possible.	“Left Battery Cycle count is: 65535，Right Battery Cycle count is: 16”
Beyond the number of the right battery recycling times	Battery life will do, replace it as soon as possible.	“Left Battery Cycle count is: 16，Right Battery Cycle count is: 65535”

5.6.1.4 Battery Volt Exception

Operation	Warning	Log
Left battery Volt Exception	Left battery voltage is low, please insert the adapter or power off the system, otherwise, the system will be shut down after XX seconds!	“2009-9-7,3:11:19 U2118Monitor: Left Battery voltage is low: left battery volt is: 12.16V”
Right battery Volt Exception	Right battery voltage is low, please insert the adapter or power off the system, otherwise, the system will be shut down after XX seconds!	“2009-9-7,3:11:19 U2118Monitor: Right Battery voltage is low， Right battery volt is: 12.15V”

Left battery volt exception, shutdown state	None	“2009-9-9,3:11:19 U2118Monitor: Left Battery Volt Exception, Shutdown State”
Right battery volt exception, shutdown state	None	“2009-9-9,3:11:19 U2118Monitor: Right Battery Volt Exception, Shutdown State”

5.6.1.5 Battery Current Exception

Operation	Warning	Log
Battery current exception	The current difference of the two batteries is out of range, please insert the adapter or power off the system, otherwise, the system will be shut down after XX seconds!	“2009-9-7,3:45:19 U2118Monitor: The difference in battery discharge current is out of range, Left battery current is: -2.604A, Right battery current is: -2.663A”
Right battery current exception, shutdown state	None	“2009-9-9,3:45:19 U2118Monitor: Left Battery Current Exception, Shutdown State” “2009-9-9,3:45:19 U2118Monitor: Right Battery Current Exception, Shutdown State”

5.6.1.6 Battery Temperature Exception

Operation	Warning	Log
Left Battery temperature is out of range	Left Battery temperature is out of range, please insert the adapter or power off the system; otherwise, the system will be shut down after XX seconds!	“2009-9-7,3:49:19 U2118Monitor: Left Battery temperature is out of range，left battery temperature is: 36.0 centigrade”
Right battery temperature is out of range	Right battery temperature is out of range, please insert the adapter or power off the system; otherwise, the system will be shut down after XX	“2009-9-7,3:49:19 U2118Monitor: Right Battery temperature is out of range， right battery temperature is: 31.5 centigrade”

	seconds!	
Left battery temperature is out of range, shutdown state	None	“2009-9-9,3:49:19 U2118Monitor: Left Battery Temperature Exception, Shutdown State”
Right battery temperature is out of range, shutdown state	None	“2009-9-9,3:49:19 U2118Monitor: Right Battery Temperature Exception, Shutdown State”

5.6.1.7 Battery Break

Operation	Warning	Log
Left battery break	Battery exception! Battery charge/discharge can’t be proceeded!	“2009-9-7,3:49:19 U2118Monitor:Left Battery Break”
Right battery break	Battery exception! Battery charge/discharge can’t be proceeded!	“2009-9-7,3:49:19 U2118Monitor:Right Battery Break”

5.6.1.8 Low Battery Power

Operation	Warning	Log
Wait until the battery power is lower than 6%	Battery power is low, please insert the adapter or shutdown the system, otherwise, the system will be shut down after XX seconds!	“2009-9-7,3:49:19 U2118Monitor:Low battery power， Left battery power is:5%,Right battery power is: 7%”

5.6.2 PHV Exception Warning Verification

5.6.2.1 95V High Volt Exception

Exception	Warning	Log
+95V error	None	“2009-9-8,2:43:11 UBatMonitor::95VPower supply voltage error:%.2fV,normal region is 90V to 100V
-95V error	None	“2009-9-8,2:43:55 UBatMonitor::-95VPower supply voltage error:%.2fV,normal region is 90V to 100V”

5.6.2.2 Other PHV Warning

Exception	Warning	Log
PHV1+	Warning! Transmitting high volt error, image can't be displayed in the right way.	"2009-9-8,2:43:11 UBatMonitor::PHV1+Power supply voltage error: 62.93V(upper limit is %.2fV)"
PHV1-	Warning! Transmitting high volt error, image can't be displayed in the right way.	"2009-9-8,2:43:55 UBatMonitor::PHV1-Power supply voltage error:62.66V(upper limit is %.2fV)"
PHV2+	Warning! Transmitting high volt error, image can't be displayed in the right way.	"2009-9-8,2:43:55 UBatMonitor::PHV2+Power supply voltage error:5.08V(upper limit is %.2fV)"
PHV2-	Warning! Transmitting high volt error, image can't be displayed in the right way.	"2009-9-8,2:43:55 UBatMonitor::PHV2-Power supply voltage error:5.06V(upper limit is %.2fV"

5.6.3 Fan Warning

Stop working	Warning	Log
Left front fan	Left front fan has gone off! Please contact the service engineer	ADT7462: Left Front Fan has gone off!
Left middle fan	Left middle fan has gone off! Please contact the service engineer	ADT7462: Left Middle Fan has gone off!
Left back fan	Left back fan has gone off! Please contact the service engineer	ADT7462: Left Back Fan has gone off!
Right fan	Right fan has gone off! Please contact the service engineer	ADT7462: Right Fan has gone off!
CPU fan	CPU fan has gone off! Please contact the service engineer	ADT7462: CPU Fan has gone off!

The position of the fans is shown as the figure below:

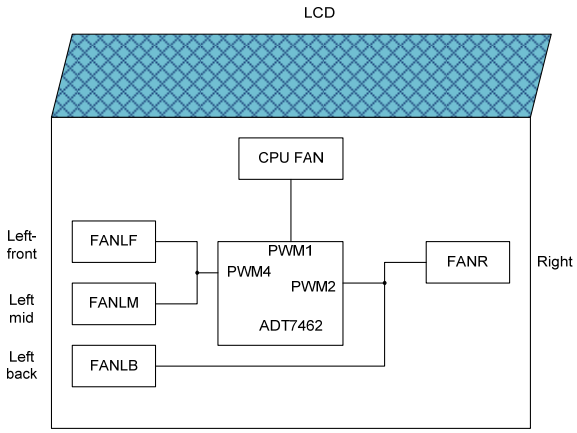


Fig 5-2 The position of the fans

5.6.4 Temperature Warning

Temp protection	Warning	Log
Main board Temperature alert	None	ADT7462: Main Board Temperature Alert
Power board temperature alert	None	ADT7462: Power Board Temperature Alert
CP temperature is beyond 105 ℃	Temperature warning, XX countdown	CPU Temperature too high, ShutDown, CPU Temperature =

5.6.5 Volt Warning

Volt	Warning	LOG
12V	None	ADT7462:12V Power supply voltage:%f, VoltLimtFloat: %f--%f
N12V	None	ADT7462:-12V Power supply voltage:%f, VoltLimtFloat: %f--%f
5V1	None	ADT7462:5.1V Power supply voltage:%f, VoltLimtFloat: %f--%f
3V3	None	ADT7462:3.3V Power supply voltage:%f, VoltLimtFloat: %f--%f
1V5	None	ADT7462:1.5V Power supply voltage:%f, VoltLimtFloat: %f--%f
2V8	None	ADT7462:2.8V Power supply voltage:%f, VoltLimtFloat: %f--%f
1V8	None	ADT7462:1.8V Power supply voltage:%f, VoltLimtFloat: %f--%f
1V2	None	ADT7462:1.2V Power supply voltage:%f, VoltLimtFloat: %f--%f

6 Function and Performance Checking Method

6.1 Note

The chapter supplies the detailed method for product main function and performance checking. This is used for referring or studying by engineer but not required.

6.2 System Running Status

6.2.1 Running Status

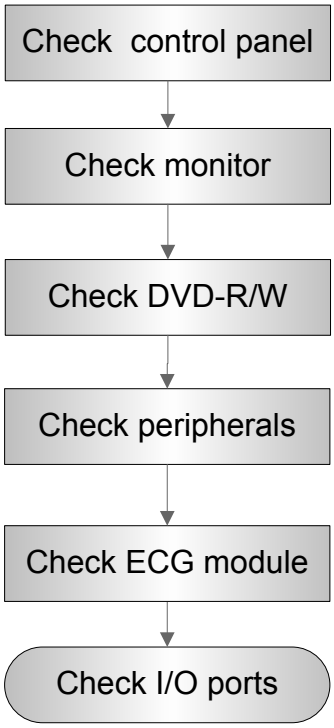
1. Power on/off normal (duration time is normal), no abnormal sounds or phenomena occur during normal operation.
2. After ultrasound system is turned on, the fan starts working and no abnormal sound when the fan is working.
3. Check if configuration, software version are normal through the [About] in preset menu.
4. Check if contrast and brightness of the monitor are normal.
5. Check if time and date are valid and correct.
6. Check if all status indicators are normal.
7. Check all log records with user, to confirm if there is any abnormality.

6.2.2 Working Condition

Check the ambient temperature and humidity. The measurements related to safety features are particularly sensitive to humidity. If the insulation feature of the system deteriorates due to the increase of system service time or system malfunctions, the fluctuation range of measurement results are likely to increase with the increase of humidity.

6.3 General exam

6.3.1 Check Flow



6.3.2 Checking Content

6.3.2.1 Check Control Panel

Procedure	Checking standard
check all buttons, keys and knobs Follow the direction: left to right, and up to down.	All keys and knobs are effective.
Function checking of the trackball: ■ Press the <Freeze> key to enter the Freeze status. ■ Press <Measure> to enter into measure status, do vertical and horizontal measurement, or do other trackball operations.	The trackball can be rotated easily; the cursor responds sensitively, the rotation direction is the same as the direction of the cursor.

6.3.2.2 Check the Monitor

Procedure	Standard
■ Adjust LCD brightness Enter [Preset]->[Peripheral preset], On the “Input & display” page: ■ click [default] ■ Click “cold/warm” ■ Monitor maintenance Log on as Service, click [Maintenance]->[Main Monitor] to check the monitor functions	■ Press 『Fn』and 『→』, the brightness increases; and press 『Fn』and 『←』, the brightness decreases. ■ Brightness load factory values. ■ Color temperature of LCD will be changed correspondingly. ■ Click each functional button, the LCD responds correctly, the standard is as follows: 1. Light-spot: 0; flash point: 0. 2. The adjoining dark spots are no more than 3 pairs, and there is no adjoining dark spot in image area. 3. There is no adjoining dark spot of 3 or more than 3. 4. The dark spots are no more than 7 and those in the image area are no more than 2 5. The distance between bad spots is no less than 5mm. Note: image area refers to rectangle when the background is black/right.

6.3.2.3 Check DVD-R/W

Procedure	Standard
■ Press [Eject] ■ Use the optical disk drive to read and burning.	■ Disk can be normally ejected. ■ Normal, no abnormal sounds.

6.3.2.4 Check Peripherals

Procedure	Standard
Footswitch: Connect the footswitch; check the functions of footswitch according to the functions listed in Key Config. （e.g. right key- image frozen, middle key- color print, left key- B/W print）	■ Press the freeze key (the right key), image is frozen, the freeze menu is displayed; press the key again, image is unfrozen. ■ Press the print key (middle key), color printing starts. ■ Press the print key (left key), B/W printing starts.
Video printer: Check if the video printer and ultrasound system are correctly connected. Then check the function of each key.	Press <Print> key, the printer begins to work, no image print deficiency or degradation. Switch video output port; repeat the step.
Text/graph printer: Check if the printer and ultrasound system are correctly connected. Then check the function of each key.	Press <Print> key, the printer begins to work, no print deficiency or degradation.

6.3.2.5 Check ECG Module

Procedure	Standard
Confirm if the ECG module is configured, then: Set [ECG] as “On”.	■ ECG trace is displayed; the heart icon is displayed at the upper right corner of the screen. ■ The parameters [Speed], [ECG Gain] can be adjusted. ■ ECG signal can be reviewed correctly.

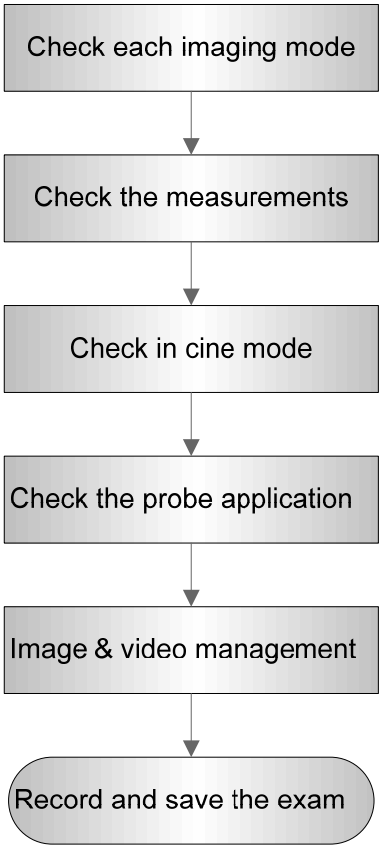
6.3.2.6 Check I/O Ports

Procedure	Standard
Checking the main I/O ports: Besides the video port, USB ports, the other ports required to be checked including: ■ S-video port; ■ Connect external VGA/LCD monitor Network port.	■ The contents displayed on the VGA/LCD are the same as those displayed on the ultrasound system displayer, no character and image loss, no color difference, no fluttering and flicking. ■ Smooth communication.

6.4 Function Checking

NOTE: A complete function inspection is described here, do the checking according to the actual system configuration.

6.4.1 Checking Flow

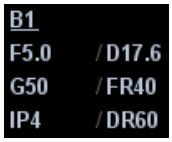

Check each imaging mode
Check the measurements
Check in cine mode
Check the probe application
Image & video management
Record and save the exam

6.4.2 Content

6.4.2.1 Imaging Modes

1. B mode

- In B Mode scanning, the image parameter area in the upper left corner of the screen will display the real-time parameter values as follows:



Display	F 5.0	D 17.6	G 50	FR 40	IP 4	DR 60
Parameter	Frequency	Depth	Gain	Frame Rate	B IP	B Dynamic Range

- Parameters that can be adjusted to optimize the B Mode image are indicated in the following.

Adjustment	Items
Control Panel	Gain, Depth, TGC, iTouch

Adjustment	Items
Menu and Soft Menu	Dynamic Range, Focus Number, FOV Position, Line Density, IP, Colorize, L/R Flip, Rotation, Persistence, Colorize Map, U/D Flip, iTouch, Frequency, Gray Map, Focus Position, iClear, FOV, Smooth, TSI, Curve, Gray Rejection, γ, High FR, iTouch Bright, A. power, B Steer, iBeam, Trapezoid, Image Merge

1. Control Panel

Procedure	Standard
Press <B>	Enter B mode, and B image displays
Gain adjustment. Rotate <iTouch>	Rotate clockwise to increase Rotate anticlockwise to decrease
Depth Adjustment Press <Depth/> direction key.	The image depth will be changed. The adjustable depth values vary depending upon the probe types.
TGC adjustment Adjust through the 8-segment toggles	Push the toggle to the right to increase the corresponding area brightness Push the toggle to the left to decrease the corresponding area brightness About 1.5s after the adjustment is finished, the TGC curve disappears.
iTouch Press <iTouch>	iTouch sign will be displayed in the image area to activate image effect auto optimization.
Image Magnification Press <zoom> to light on the Zoom indicator.	Roll the trackball to change position of the magnified image. Press <Zoom> in zoom status to exit the mode, the current window returns to the display before zoom. Configured with image menu “Magnify” to realize different Magnification.
Press <B>, and then press	● Enter dual mode, and the right image is activated ● Press again to switch between the windows
Press <B>, and then press	● Press 4 times, and 4 images will be displayed on the screen with only one image activated at one time ● Press again to switch among the windows
Press <B>	To enter single mode in multiple window mode, or to exit from other modes.

2. Menu

Procedure	Standard
Frequency B mode menu→ [Frequency]	Frequency value is displayed in real time in the left upper part of the screen via adjusting. The frequency scales of different probes are not the same.
Focus B mode menu→	Focus number or position can be adjusted. The focus position symbol is displayed on the right side of the image.

[Focus Number]/[Focus Position]	
Dynamic Range B mode menu-> [Dynamic Range]	to the dynamic range can be adjusted, the real time value will be displayed on the image parameter area in the upper right of the screen. As the dynamic range increases, the darker the image and the contrast, as well as the noise may increase.
Line Density B mode menu-> [Line Density]	Click [Line Density], and rotate the multifunction knob to adjust the parameter. The higher the line density, the higher the resolution, and the lower the frame rate.
iClear B mode menu-> [iClear]	Click [iClear] to adjust, off represents no iClear is turned on, and the bigger the value the stronger the effect. The bigger the value the more clearly the profile of the image.
B mode menu-> [U/D Flip]/[L/R Flip] B mode menu-> [Rotate]	B mode menu-> [U/D Flip]/[L/R Flip] When you flip or rotate an image, the “M” mark will change its position on the screen; the M mark is located in the upper left corner of the imaging area by default.

2. M mode

- In M mode scanning, the image parameter area in the upper left corner of the screen displays the real-time parameter values as follows:

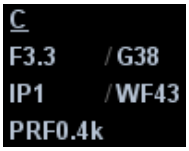
Display	V 3	IP 6	DR 65	G 45
Parameter	M Speed	M IP	M Dynamic Range	M Gain

- Parameters that can be adjusted to optimize the M mode image are indicated in the following.

Adjustment	Items
Control Panel	Gain, TGC, Depth
Menu and Soft Menu	IP, Time Mark, Speed, Colorize, Colorize Map, Acoustic Power, Edge Enhance, Frequency, Gray Map, Focus Position, Dynamic Range, M Soften, Curve, Gray Rejection, γ, Display Format

3. Color mode

- In Color mode scanning, the image parameter area in the upper left corner of the screen displays the real-time parameter values as follows:



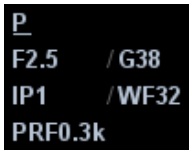
Display	F 3.3	G38	IP 1	WF 43	PRF 0.4k
Parameter	Frequency	Color Gain	Color IP	Color Wall Filter	Pulse Repetition Frequency PRF

- Parameters that can be adjusted to optimize the Color mode image are indicated in the following.

Adjustment	Items
Control Panel	Gain, Depth
Menu and Soft Menu	B/C Wide, Frequency, Priority, Baseline, Packet Size, Dual Live, Color IP, Map, A. power, Focus Position, Scale, Flow State, WF, Invert, Line Density, Smooth, Persistence, B Display, Steer

4. Power mode

- In Power mode scanning, the image parameter area in the upper left corner of the screen displays the real-time parameter values as follows:



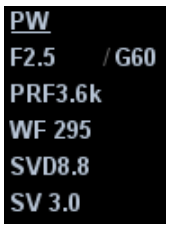
Display	F 2.5	G 38	IP 1	WF32	PRF 0.3k
Parameter	Frequency	Power Gain	Power IP	Power Wall Filter	Pulse Repetition Frequency PRF

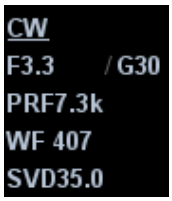
Parameters that can be adjusted to optimize the Power mode image are indicated in the following.

Type	Parameter
Control Panel	Gain, TGC, Depth
Menu and Soft Menu	B/C Wide, Frequency, Priority, Dynamic Range, Packet Size, Dual Live, Power IP, Map, Acoustic Power, Focus Position, Scale, Flow State, Wall Filter, Invert, Line Density, Smooth, Persistence, B Display, Steer

5. PW/CW mode

In PW/ CW mode scanning, the image parameter area in the upper left corner of the screen displays the real-time parameter values as follows:





PW	Display	F 2.5	G 60	PRF 3.6k	WF295	SVD 8.8	SV 3.0
	Parameters	Frequency	Gain	Pulse Repetition Frequency PRF	WF (Wall Filter)	SV Position	SV Size
CW	Display	F 3.3	G 30	WF407	PRF 7.3k		SVD 35.0
	Parameters	Frequency	Gain	WF (Wall Filter)	Pulse Repetition Frequency PRF		SV Position

Parameters that can be adjusted to optimize the PW/ CW mode image are indicated in the following.

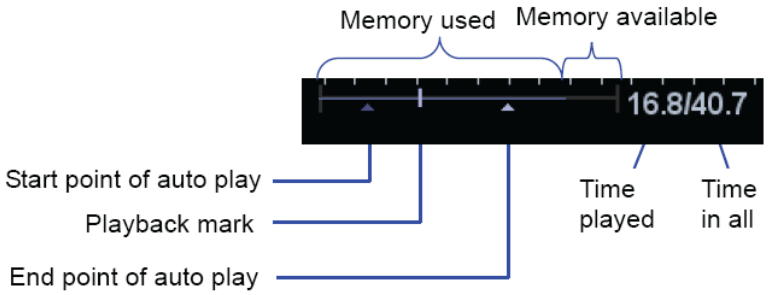
Adjustment		Items
Control Panel		Gain, TGC, Depth
Soft Menu & Menu	PW	Invert, SV, WF, Frequency, Duplex/Triplex, V Max, V Mean, Audio, Trace Area, Colorize Map, Speed, Acoustic Power, Trace Sensitivity, T/F Res, Gray Map, Dynamic Range, Scale, Baseline, Colorize, Quick Angle, Angle, Trace Smooth, Time Mark, HPRF, Curve, Gray Rejection, γ, Display Format, Auto Calculation, Auto Calculation Parameter, PW Steer
	CW	WF, Invert, Colorize Map, Frequency, Speed, V Max, V Mean, Dynamic Range, Audio, Trace Area, Trace Sensitivity, Gray Map, Scale, Baseline, Colorize, Quick Angle, Angle, Acoustic Power, Trace Smooth, Time Mark, T/F Res, Curve, Gray Rejection, γ, Display Format, Auto Calculation, Auto Calculation Parameter

6.4.2.2 Basic Measurements

Procedure	Standard
In B image mode: Press <Measure>	The system enters general measurement mode. Perform any 1-2 measurements (e.g., length, area), the results will display at the right lower part of the image.
Press the same key again or press <Esc>.	Exits measurement.
Do the same operation in other image modes.	Application measurements are classified into different application packages, do the application measurements selectively.

6.4.2.3 Cine Review

Procedure	Standard
Press [Freeze] key to freeze an image, and the [Cine] key indicator lights on. The system automatically enters the manual cine status.(It has been set that when system enters into freeze mode, the default status is cine review.) Press <iStation> key, then click [Review]; or press <Review> key to open a cine file.	The system enters into cine review status The system enters into auto cine review status.
Roll the trackball	Manual cine review
Click [Auto Play] on the menu or soft menu.	Auto play function is turned on, adjust the soft menu button. The greater the value is, the quicker the speed is. When the value is 0, the system exits auto play mode.
Move the cursor onto the desired start point of the cine loop, click [Set First Frame] in the menu or soft	Set the start point of cine loop.

menu to set the start point.	
Move the cursor onto the desired end point of the cine loop, click [Set Last Frame] in the menu or soft menu to set the start point.	Set the end point of cine loop.
Click [Auto Play] again	Review region is confined to the set start point and end point.
Then press the [Cine] key again.	Cine review stops.
Press the <Freeze> key to unfreeze the image. Press <Cine> or <Esc> key.	Freeze indicator light is off; the system will return to image scanning and exit cine review. The images are still frozen but the system exits cine review.
	

6.4.2.4 Probe Switching

Procedure	Standard
Press <Freeze> key→ connect the probe to the system→ press <Freeze> key→ press <Probe> key to select the probe.	Connect a convex probe to probe socket A, and then connect a linear probe to probe socket B, the operator can select probe A or probe B as the active probe.
Press <Freeze> key→ disconnect the probe→ connect another probe to the port	The system can recognize the newly connected probe in no time.

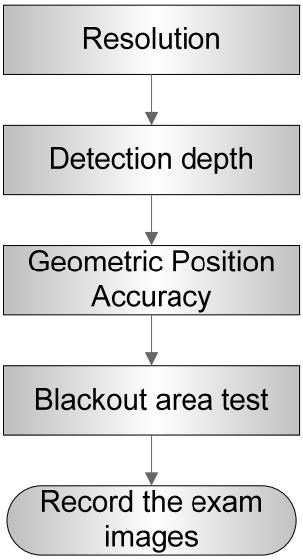
6.4.2.5 Patient Information Management

Procedure	Standard
Press <Save> (the function already set) during image scanning	Image will be saved to the patient database, and a thumbnail will be displayed at the right part of the screen.
Open [Setup] →[System Preset]→"General", then check "Send/Print Image after End Exam" in the Patient Management area. Press <End Exam> during image scanning	The system automatically sends the images of the exam to the default DICOM storage server or print server.
● Press <Review> key. ● Click [Exit] on the Review screen; or, press <Review> again, or, press <Esc> key	● The system enters into image review mode. ● The system exits image review mode.

● Click [iVision] on the other menu; or press user-defined iVision key. ● Select the contents to be demonstrated, and select the demo mode in the iVision screen. Then select an item already added to the list and click [Start] ● When the demonstration is finished, click [Exit] or press <Esc>.	● Open iVision screen: ● Demonstration begins. ● Image files are played according to file names one by one (including the image of system-relevant and PC-compatible format). ● The system exits the demonstration.
Press <iStation> key to enter patient information management (iStation page)	The saved patient information (images) can be found, and the patient information can be: ● Backed up/ Restored ● Sent (To DICOM.U disk .etc)

6.5 Performance Test

6.5.1 Test Process



6.5.2 Test Content

NOTE:	The image used here is only for reference, stick to the image effect in the real situation.

Requirements:

1. Display: set the contrast and brightness at the clinical application value (or the default status)
2. Operation environment: dark room, simulating the clinical application environment.
3. Scanning techniques: contact the probe with the acoustic window of the phantom, no spacing nor pressing.

Tips:

For the testing phantoms, please refer to Appendix B.

KS107BD is low frequency phantom and used when Probe focus frequency is less than 4MHZ;

KS107BG is high frequency phantom and used when Probe focus frequency is more than 5MHZ;

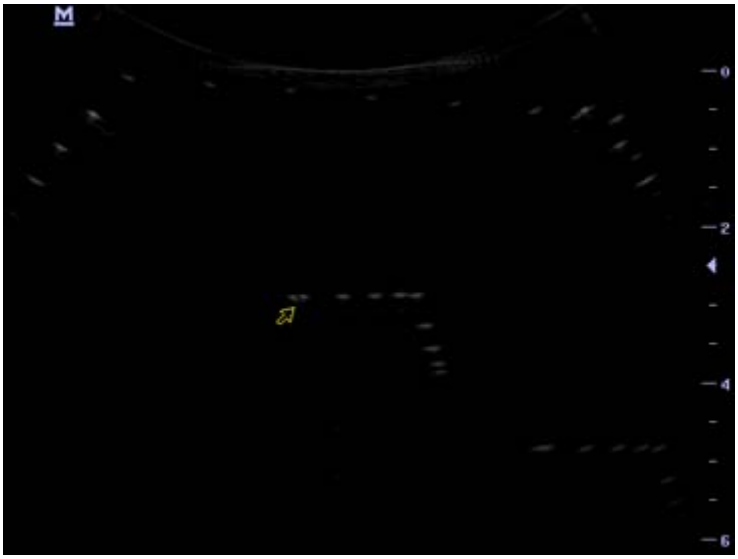
6.5.2.1 Resolution

■ transverse resolution

Test Step:

1. Cover the scan surface of the phantom with water or couple gel, gently contact the probe with the scan surface, making the transverse resolution testing targets to be displayed around the midline of the image.
2. Adjust the focus point focuses at the position where the transverse resolution testing targets are displayed.
3. Adjust parameters like gain, dynamic range, TGC, making the background tissue unseen, just displaying the target image clearly.
4. In condition that the transverse resolution testing targets are horizontally displayed, record the minimal distance of two targets that can be clearly recognized.
5. Repeat the operation above for the transverse resolution testing targets at other depths.

As shown in figure below.

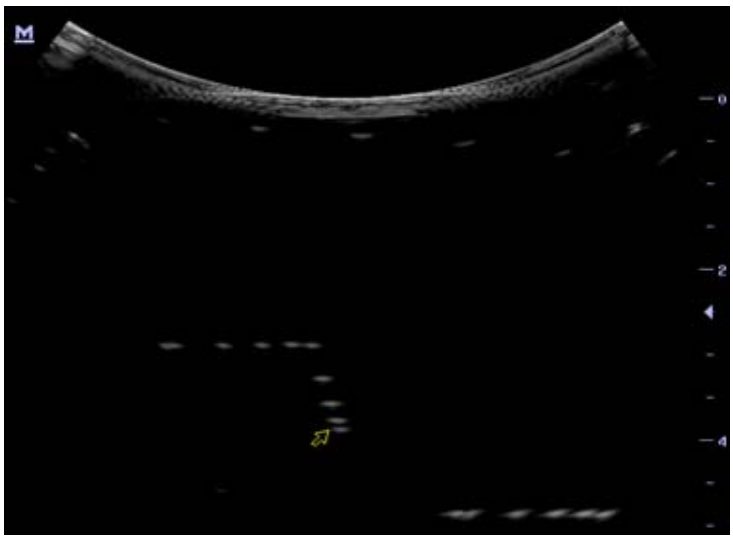


■ Axial resolution

Test Step:

1. Cover the scan surface of the phantom with water or couple gel, gently contact the probe with the scan surface, making the longitudinal resolution testing targets to be displayed around the midline of the image.
2. Adjust the focus point focuses at the position where the longitudinal resolution testing targets are displayed.

3. Adjust parameters like gain, dynamic range, TGC, making the background tissue unseen, just displaying the target image clearly.
4. Record the minimal distance of two longitudinal resolution testing targets that can be clearly recognized.
5. Repeat the operation above for the longitudinal resolution testing targets at other depths.



NOTE:	1.	When using the convex probe, keep the transverse resolution testing targets to be displayed near the midline.
	2.	When using a linear probe with steer function, do not turn on the steer function when perform the transverse resolution test.
	3.	Zoom in the region where the targets located if necessary.
	4.	The diameter of the target point at a certain depth is equal to the transverse resolution at the depth.

6.5.2.2 Maximum Depth

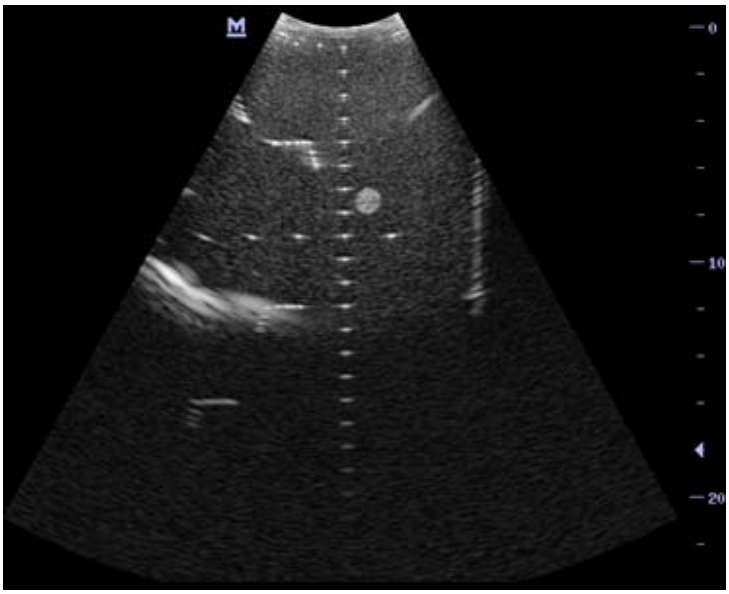
Test Step:

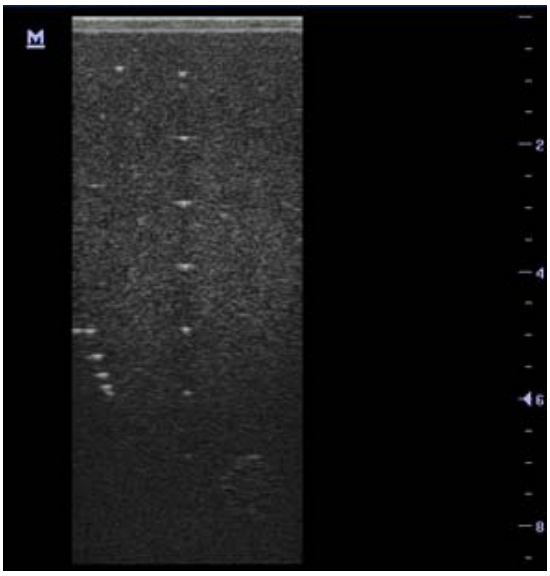
1. Cover the scan surface of the phantom with water or couple gel, gently contact the probe with the scan surface
2. Set the system display depth according to the eXPcted maximum available depth of the probe in use.
3. Adjust the focus point to the deepest, and AP at the maximum value.
4. Set gain, contrast, TGC at a greater value, but no halation nor defocus is allowed.
5. Record the depth of the furthest target (the target can be seen clearly).

NOTE:	1.	Increasing the gain will also increase the noise, and echo may be covered.
	2.	When using a linear probe, please completely contact the probe with the scan surface, no side clearance is allowed.

3. When using a convex or phased-array probe, make the axis targets to be displayed at the middle of the scanning image.
4. When system is not frozen, the fast field target information may be similar to that of the noise, do not use this target.

As shown in figure below.





6.5.2.3 Geometric positioning accuracy

■ Longitudinal geometric positioning accuracy

Test Step:

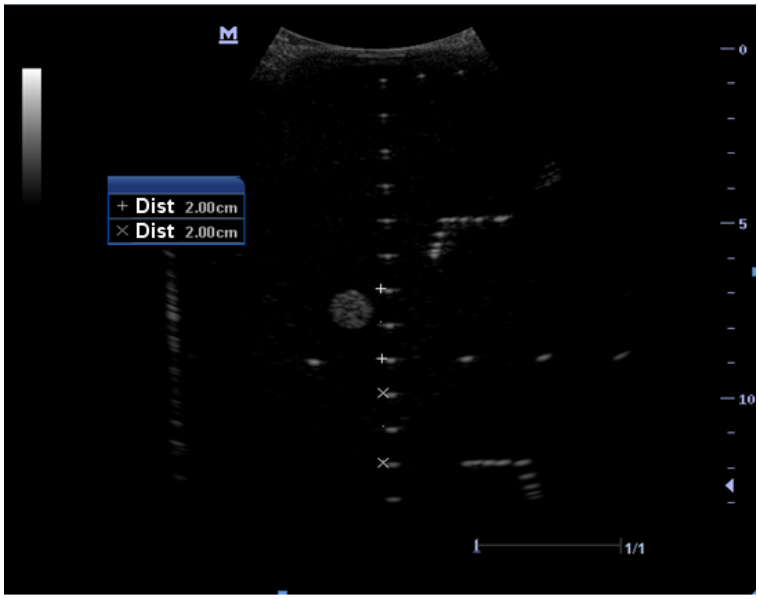
1. Do adjustments as the way in testing the maximum depth.
2. Record the distance by 20mm each segment on the longitudinal targets line using the measurement caliper;
3. Select the value with the greatest error (to 20mm), calculate the accuracy using the formula

below

$$\text{Geometric Position Accuracy (\%)} = \left| \frac{\text{Measured value-Actual distance}}{\text{Actual distance}} \right| \times 100$$

NOTE:	1. The measurement caliper should be positioned at the upper edge of the target, not the middle nor the lower edge. 2. The scanning plane should be vertical to the target line, that means the scanning plane is parallel with the cross-section of the phantom

As shown in figure below.



■ Transverse geometric positioning accuracy

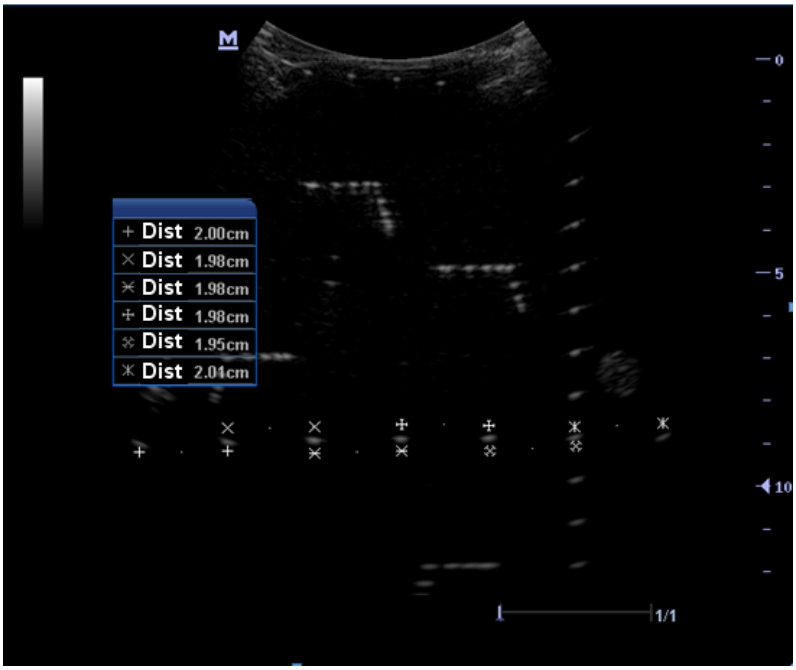
Test Step:

1. Cover the scan surface of the phantom with water or couple gel, gently contact the probe with the scan surface
2. Adjust the depth, making the transverse targets to be displayed in the image.
3. Adjust the focus point to be posited beside the transverse targets (the standard is not clear)
4. Adjust parameters like gain, TGC, making each transverse targets to be clearly displayed.
5. Record the distance by 20mm each segment on the transverse targets line by using the measurement caliper
6. Select the value with the greatest error (to 20mm), calculate the accuracy by using the formula below

$$\text{Geometric Position Accuracy (\%)} = \left| \frac{\text{Measured value-Actual distance}}{\text{Actual distance}} \right| \times 100$$

NOTE:	1. When using a linear probe, record the transverse distance by segment. 2. When using a convex probe, all transverse targets should be displayed integrally in an image. 3. The measure caliper should be posited at the upper side or lower side of the target center.

As shown in figure below.



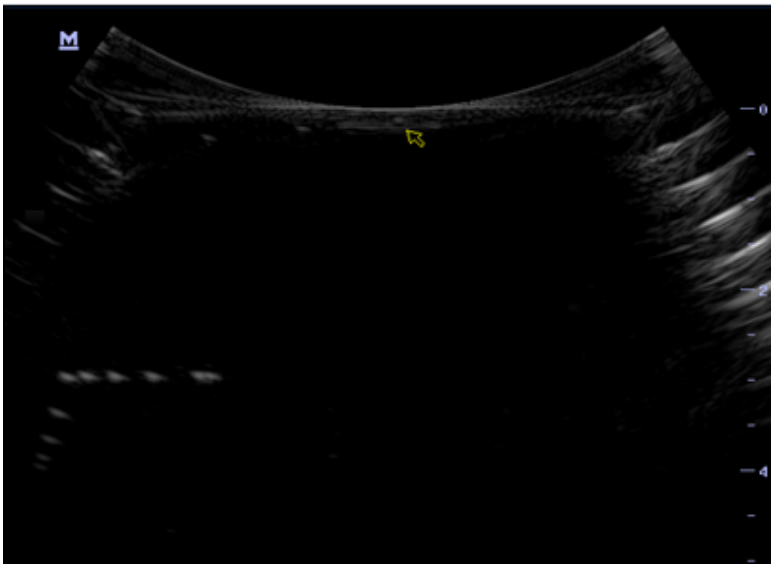
6.5.2.4 Blackout Area

Test Step:

1. Cover the scan surface of the phantom with water or couple gel, gently contact the probe with the scan surface
2. Adjust the depth at a lower value, and set the focus at the nearest place to the scan surface.
3. Decrease the value of parameters like AP, Gain until the background noise just can be seen.
4. Record the smallest depth of the target that can be seen clearly, that value is the blackout area value.

NOTE:	1. When using a linear probe, please completely contact the probe with the scan surface, no side clearance is allowed. 2. For convex probe, the targets in the blackout area should be positioned on the midline of the scanning plane.

As shown in figure below.


M

7 System Self-diagnosis

7.1 Screen Introduction

The booting screen of the self-diagnosis system is:

Fig 7-1 Interface of System Self-Diagnosis and Boot

The main interface of self-diagnosis system

There are 3 kinds of main interfaces of self-diagnosis system: manufacturing, customer service and user, as shown in figures below:

The self-diagnosis interface of manufacturing and customer service can be divided into 4 regions.

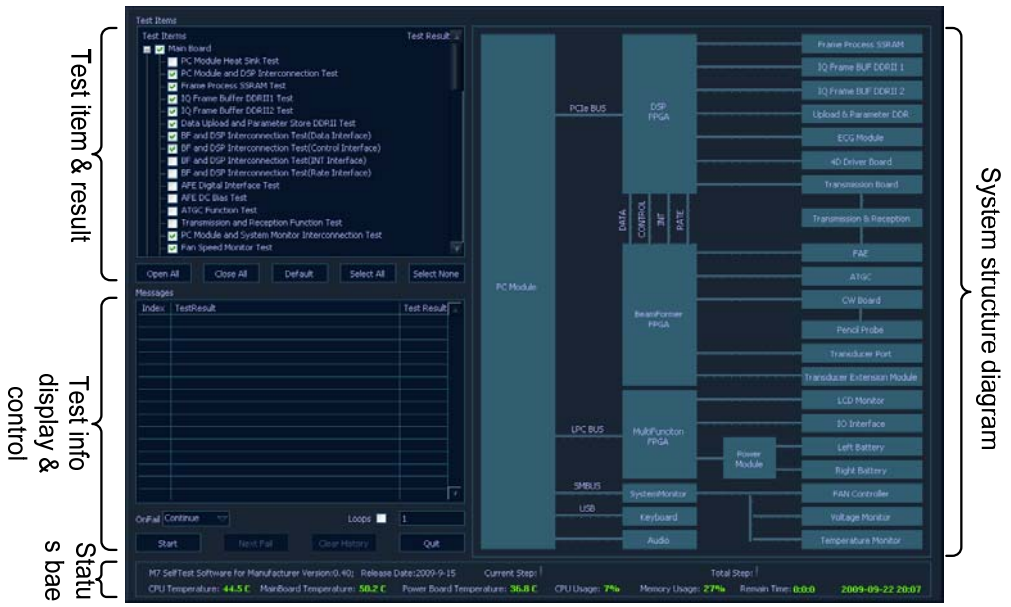


Fig 7-2 Self-diagnosis Interface, Manufacturing

Fig 7-3 Self-diagnosis Interface, Customer Service

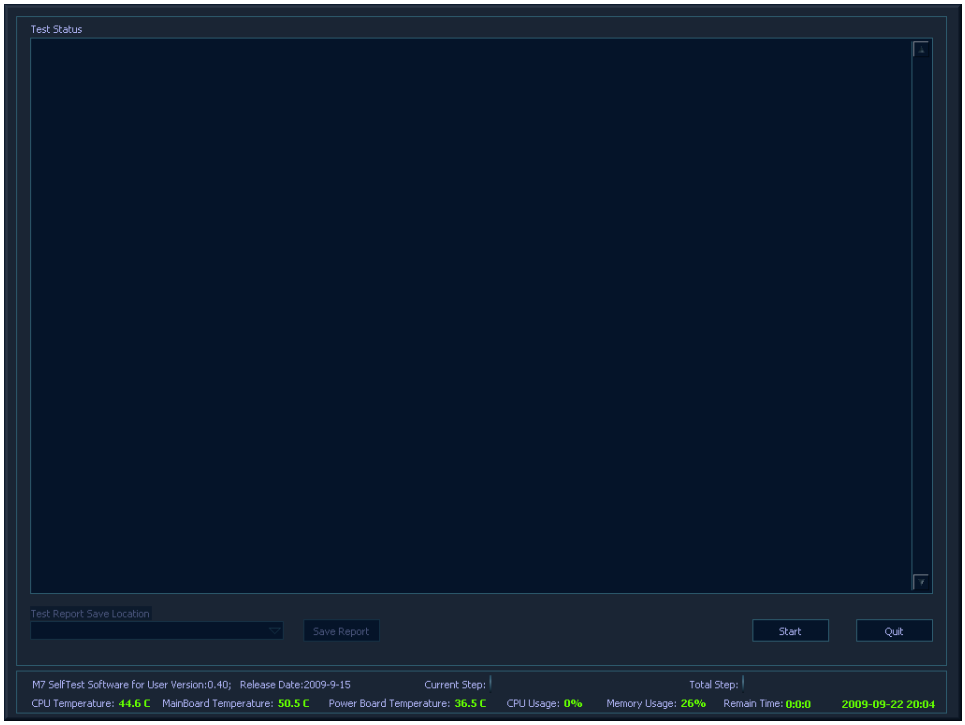


Fig 7-4 Self-diagnosis Interface, User

Test Report Save Location: display the removable storage media (such as USB disk, removable HDD), if no removable storage media is connected; or, if the system is undergoing the test, this selection is not available.

Save Report: save the tested data to the root of the specified logic disk, if no logic disk is specified; or, if the system is undergoing the test, this selection is not available.

Start/Stop: Start/Stop the test;

Shut Down: shut down the program, and shut down the system automatically.

Interface of tested results

Displays the test results, not available for the user.

Fig 7-5 Interface of testing results

Test Report Save Location: display the removable storage media (such as USB disk, removable HDD), if no removable storage media is connected; or, if the system is undergoing the test, this selection is not available.

Save Report: save the tested data to the root of the specified logic disk, if no logic disk is specified; or, if the system is undergoing the test, this selection is not available.

Shut Down: shut down the program, and shut down the system automatically.

7.2 Region of Self-diagnosis Items and Testing Results

Configuration of testing items

In this region, the testing items are divided into parent items according to boards and there are several sub items for each parent item. The testing items can be customized according to requirements. If the check box before an item is selected (☑), this item is in the testing list; contrariwise, if the check box before the item is deselected (☐), this item is not in the testing list. When a parent item is selected, all the sub items of this item are selected by default; contrariwise, when deselecting a parent item, all the sub items of this item are deselected by default.

OutDentAll: click this button to unfold all test items if they are folded;

InDentAll: click this button to fold all test items if they are unfolded;

Default: click this button to select all the items to be tested by default;

SelectAll: click this button to select all test items;

SelectNone: click this button to deselect all test items selected.

Display of Testing Results

The testing result is displayed behind each sub item. For the sub item, if an item passes the test, it is marked with green “PASS”; if not, it is marked with red “FAIL”; if the item is not selected, it is marked with “Skip” of normal color. See Fig 8-11.

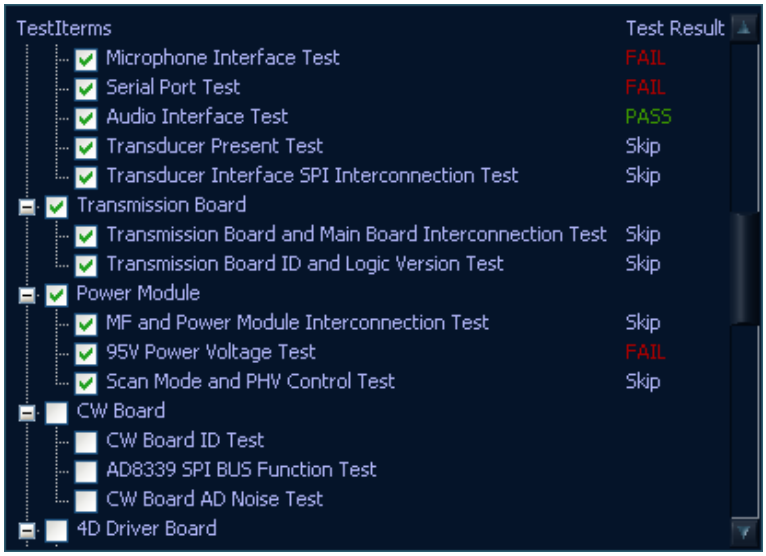


Fig 7-6 Test Results of Items in Testitems Table

Test Result Navigation

After the test is completed, click the test items in Testitems, the program will show the corresponding detailed test results, which will be displayed in the first line of Message.

7.2.1 Info Display Area

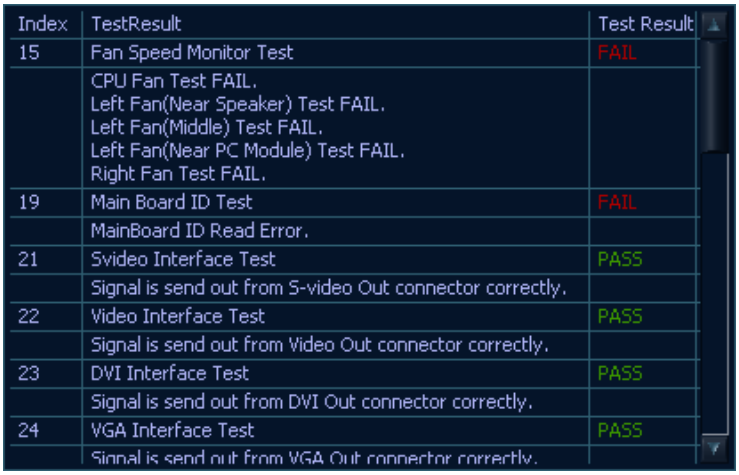
Test information

The area displays test results.

Messages list: display test information of each test item.

Index is the number of test, namely the index number corresponding sub items;

TestResult is the name and detailed test information of test items, as shown in Fig 8-12.



Index	TestResult	Test Result
15	Fan Speed Monitor Test	FAIL
	CPU Fan Test FAIL. Left Fan(Near Speaker) Test FAIL. Left Fan(Middle) Test FAIL. Left Fan(Near PC Module) Test FAIL. Right Fan Test FAIL.	
19	Main Board ID Test	FAIL
	MainBoard ID Read Error.	
21	Svideo Interface Test	PASS
	Signal is send out from S-video Out connector correctly.	
22	Video Interface Test	PASS
	Signal is send out from Video Out connector correctly.	
23	DVI Interface Test	PASS
	Signal is send out from DVI Out connector correctly.	
24	VGA Interface Test	PASS
	Signal is send out from VGA Out connector correctly.	

Fig 7-7 Interface of Testing Results

Test Configuration

Onfail drop-down list: there are two options, “Continue” and “Stop”. If you select [Continue], the test will continue even though a test item fails during testing; however, if you select [Stop], the test will stop once a test item fails during testing.

Start button: click to test the selected items one by one, and the button turns to [Stop] at the same time. During the test, click [Stop] to stop the test. After the test is completed, the [Stop] button turns to [Start], ready for the next test.

Next Fail: after the test is completed, click [Next Fail] to show the next failed test item in the Message list, and the related information will be displayed in the first line. If already navigated to the last line, then the query will begin from the first line.

Clear History: click to clear all data in Testitems and Messages list, and recover the flow chart to the initial status.

Loops check box: check this item to perform loop test. If it is checked and the loop test number is input at the right side, the test will be performed as many as the number you set. If the number is less than 0, the test will be cycled, until it was manually stopped or any error appeared.

Quit: for user operation, click the button to exit the self-diagnosis and shut down the system; for manufacturer and service engineer operation, click this button to exit the test interface and then to view the tested results.

7.2.2 Status Bar

When the program is running, the version and issued date will be displayed on the left side of the status bar: M7 SelfTest Software for Manufacture Version: xx; Release Date: YYYYMMDDXX. During the test, the software version in the status bar will turn to the name of the item on test.

During the test, the test progress of current item and the total test progress are also displayed in the status bar.

Besides, the following items are also displayed in the status bar: temperature of CPU, main board and power module, occupation rate of CPU and memory, remaining test time and current time.

Fig 7-8 Sketch Map of Status Bar

When the temperature goes beyond the working temperature, the value will be displayed in red. The normal range is listed below:

Temperature type	Lower limitation	Upper limitation
CPU temperature	0	100
Main board temperature	-10	78
Power board temperature	-10	70

7.2.3 Test Report

Save the test report

Non-loop test

For the non-loop test, the test result will be saved in D:\M7\log\Selftest\Test Report. The result of the former test will be deleted after the new test is completed.

Loop test

For the loop test, the test result will be saved in D:\M7\log\Selftest\Test Report Loop_N. The test result is PASS or FAIL, N refers to the test times.

Meanwhile, after each test is finished, the current test result will be automatically compressed into Loop Test Reports.zip, and the test data will be deleted.

The test report is in the format of HTML, which can be opened by IE browser by default. The test report is shown as below:

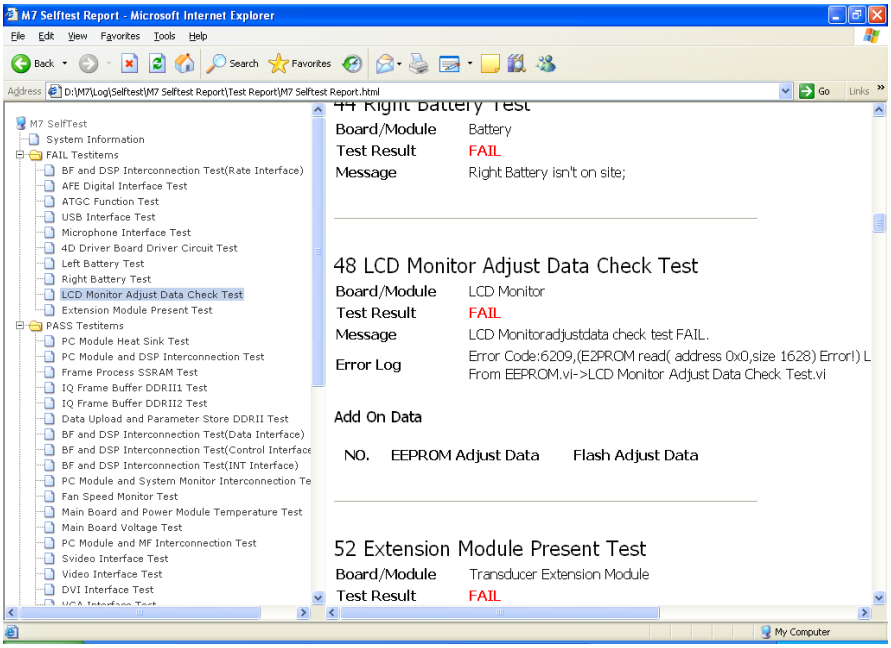

M7 Selftest Report - Microsoft Internet Explorer
M7 SelfTest
System Information
FAIL Testitems
BF and DSP Interconnection Test(Rate Interface)
AFE Digital Interface Test
ATGC Function Test
USB Interface Test
Microphone Interface Test
4D Driver Board Driver Circuit Test
Left Battery Test
Right Battery Test
LCD Monitor Adjust Data Check Test
Extension Module Present Test
PASS Testitems
PC Module Heat Sink Test
PC Module and DSP Interconnection Test
Frame Process SSRAM Test
IQ Frame Buffer DDRII1 Test
IQ Frame Buffer DDRII2 Test
Data Upload and Parameter Store DDRII Test
BF and DSP Interconnection Test(Data Interface)
BF and DSP Interconnection Test(Control Interface
BF and DSP Interconnection Test(INT Interface)
PC Module and System Monitor Interconnection Te
Fan Speed Monitor Test
Main Board and Power Module Temperature Test
Main Board Voltage Test
PC Module and MF Interconnection Test
Svideo Interface Test
Video Interface Test
DVI Interface Test
44 Right Battery Test
Board/Module Battery
Test Result FAIL
Message Right Battery isn't on site;
48 LCD Monitor Adjust Data Check Test
Board/Module LCD Monitor
Test Result FAIL
Message LCD Monitoradjustdata check test FAIL.
Error Log Error Code:6209,(E2PROM read(address 0x0,size 1628) Error! L
From EEPROM.vi->LCD Monitor Adjust Data Check Test.vi
Add On Data
NO. EEPROM Adjust Data Flash Adjust Data
52 Extension Module Present Test
Board/Module Transducer Extension Module
Test Result FAIL
My Computer

Fig 7-9 Test Report

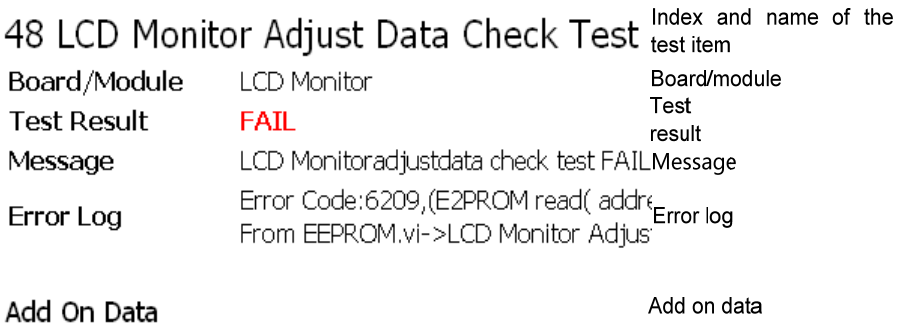
The left side is the test item list, which is classified according to the test results, besides, system information is listed here; the right side are the tested data and pictures.

Click the test item in the left side, the corresponding test data will be displayed.

The test data consists of:

- Report Name
- Report time;
- The picture of the system structure (for user test, the picture displayed is the system structure in the factory)
- System Information;
- Test data of failed tests (if there is no failed test, then no this branch);
- Test data of passed tests (if there is no passed test, then no this branch);
- Test data of overleaped tests (if there is no overleaped test, then no this branch);

The following is an example of the test data:



- Index and name of the test item;

- Board/module;
- Test result (PASS, FAIL, and Skip, each result is displayed in different color);
- Message
- Error log (may not exist);
- Add on data (exist only when the LCD Monitor Adjust Data Check Test is failed).

Notes when open the test report:

When double click M7 Selftest Report.html using IE (Java Script is applied), it may be blocked, which can be seen in the figure below.

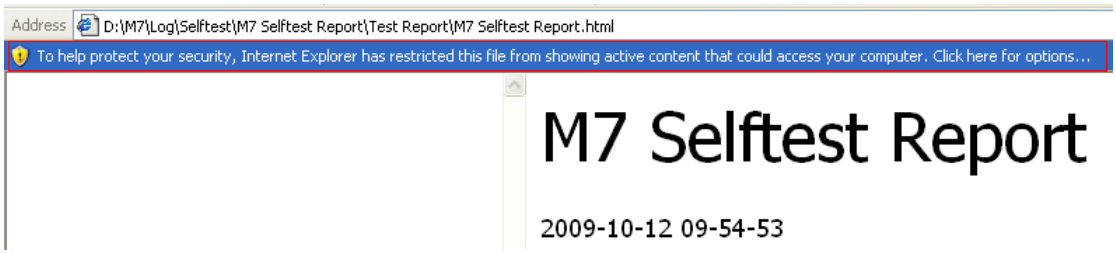

Address
D:\M7\Log\Selftest\M7 Selftest Report\Test Report\M7 Selftest Report.html
To help protect your security, Internet Explorer has restricted this file from showing active content that could access your computer. Click here for options...
M7 Selftest Report
2009-10-12 09-54-53

Fig 7-10 Internet Explorer Prompt

Right click the prompt, then click “Allow Blocked Content” (see the figure below), the report can be opened by IE in the normal way.

showing active content that could access your computer. Click here for options...
Allow Blocked Content...
What's the Risk?
Information Bar Help
M7 Selftest Report

Fig 7-11 Display the Blocked Content

7.3 Description of Self-diagnosis Test Items

（1）PC Module Heat Sink Test

■ Test Content

Test if the PC module heat sink is installed in the right way.

■ Test Description

The following screen will be opened after the test is started. There displays the current CPU working temperature, the yellow line represents the highest working temperature of the CPU, and the changing wave represents the current CPU temperature. If the temperature didn’t go beyond the limit, the waveform is displayed in green; otherwise, it is red. At the bottom of the dialogue box, there displays the current CPU temperature and the remaining test time.

The interface can't be closed manually after the test is started, until the test is completed. If the test failed, please turn off the power as soon as possible.

Fig 7-12 PC module heat sink test data display

Test results will be displayed in the Remark column of the Messages list box, and the format is:

PC Module heat sink test PASS/FAIL.

Suggestion when test failed:

Check if PC module heat sink was correctly installed, if not, reinstalled it.

（2）PC Module and DSP Interconnection Test

- Test Content

Test if the PCIe communication between PC module and DSP FPGA is normal.

- Test Description

Test results and DSP FPGA related logic version will be displayed in the Remark column of the Messages list box, and the format is:

PC Module and DSP FPGA interconnection test PASS/FAIL;

DSP Version:XX;

Build_Version:X;

Release time:XXXX.XX.XX.

- Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector
Main board	U6
Main board	U8

（3）Frame Process SSRAM Test

- Test Content

Test if there is address bus disconnected, short connected, pull high, pull low, and if the memory is damaged in SSRAM.

- Test Description

Test results will be displayed in the Remark column of the Messages list box, and the format is:

Frame Process SSRAM data bus test PASS/FAIL;

Frame Process SSRAM address bus stuck high test PASS/FAIL;

Frame Process SSRAM address bus stuck low test PASS/FAIL;

Frame Process SSRAM address bus short test PASS/FAIL;

Frame Process SSRAM full space test PASS/FAIL.

- Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector
Main board	U6
Main board	U7

（4）IQ Frame Buffer DDRII1/2 Test

- Test Content

Test if IQ frame cache DDR II works normally

- Test Description

Test results will be displayed in the Remark column of the Messages list box, and the format is:

IQ frame buffer DDRII1/2 test PASS/FAIL.

- Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector
Main board	U3
Main board	U4

（5）Data Upload and Parameter Store DDRII Test

■ Test Content

Test if data uploading and parameter storage DDR II are normal.

■ Test Description

Test results will be displayed in the Remark column of the Messages list box, and the format is:

Data Upload and Parameter Store DDRII test PASS/FAIL.

■ Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector
Main board	U5

（6）BF and DSP Interconnection Test(Data Interface)

■ Test Content

Test if the RF data bus between BF FPGA and DSP FPGA work normally.

■ Test Description

Test results will be displayed in the Remark column of the Messages list box, and the format is:

BF and DSP Interconnection Test (Data Interface) test PASS/FAIL.

■ Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector
Main board	U6
Main board	U10

（7）BF and DSP Interconnection Test(Control Interface)

■ Test Content

Test if the control bus between BF FPGA and DSP FPGA work normally.

■ Test Description

Test results will be displayed in the Remark column of the Messages list box, and the format is:

BF and DSP Interconnection Test (Control Interface) test PASS/FAIL;

BF logic version: 0xXX;

BF logic build version: 0xXXX;

BF logic release time: XXXX.XX.XX.

■ Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector
Main board	U6
Main board	U10

（8）BF and DSP Interconnection Test(INT Interface)

■ Test Content

Test if the interruption bus between BF FPGA and DSP FPGA work normally.

■ Test Description

Test results will be displayed in the Remark column of the Messages list box, and the format is:

BF and DSP Interconnection Test (INT Interface) test PASS/FAIL.

■ Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector
Main board	U6
Main board	U10

（9）BF and DSP Interconnection Test(Rate Interface)

■ Test Content

Test the Rate signal from BF FPGA, check if DSP FPGA and TX FPG can receive normally, and if the Rate related connections and logics can work normally.

■ Test Description

Test results will be displayed in the Remark column of the Messages list box, and the format is:

BF and DSP Interconnection Test (Rate Interface) test PASS/FAIL.

■ Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector
Main board	U6
Main board	U10

（10）AFE Digital Interface Test

■ Test Content

Verify if the 8 analog front-end digital interfaces are normal.

■ Test Description

Test results will be displayed in the Remark column of the Messages list box, and the format is:

AFE ADC digital Interface test PASS/FAIL;

AFE ADC0 digital Interface test PASS/FAIL;

AFE ADC1 digital Interface test PASS/FAIL;

AFE ADC2 digital Interface test PASS/FAIL;

AFE ADC3 digital Interface test PASS/FAIL;

AFE ADC4 digital Interface test PASS/FAIL;

AFE ADC5 digital Interface test PASS/FAIL;

AFE ADC6 digital Interface test PASS/FAIL;

AFE ADC7 digital Interface test PASS/FAIL.

■ Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector	Board	Connector
Main board	U10	Main board	U47
Main board	U46	Main board	U48
Main board	U52	Main board	U51
Main board	U50	Main board	U49
Main board	U1		

（11）AFE Noise Test

■ Test Content

Test if the front-end noise data is in the specified range when the analog front-end is under normal working.

■ Test Description

Test results will be displayed in the Remark column of the Messages list box, and the format is:

AFE noise test PASS.

Or,

AFE noise test PASS.

Broken channel: CHX…….

■ Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector	Board	Connector
Main board	U10	Main board	U47
Main board	U46	Main board	U48
Main board	U52	Main board	U51
Main board	U50	Main board	U49
Main board	U1		

（12）ATGC Function Test

■ Test Content

Test if ATGC functions normally.

■ Test Description

Test results will be displayed in the Remark column of the Messages list box, and the format is:

ATGC function test PASS/FAIL.

■ Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector	Board	Connector
Main board	U25	Main board	U1
Main board	U10	Main board	U47
Main board	U46	Main board	U48
Main board	U52	Main board	U51

Board	Connector	Board	Connector
Main board	U50	Main board	U49

（13）Transmission and Reception Function Test

■ Test Content

Test if the circuits related with transmitting, receiving, high-voltage isolation and high-voltage switching are normal.

■ Test Description

Test results will be displayed in the Remark column of the Messages list box, and the format is:

Transmission and Reception function test PASS ; or,

Transmission and Reception function test FAIL;

Open circuit emit receive channel: CHX……;

Short circuit emit receive channel: CHX……;

Broken high voltage switch channel: CHX…….

（14）PC Module and System Monitor Interconnection Test

■ Test Content

Test if SMBUS between the PC module and system monitor chip is correctly connected.

■ Test Description

Test results will be displayed in the Remark column of the Messages list box, and the format is:

PC module and system monitor interconnection test PASS/FAIL;

Device ID: 0xXX;

Company ID: 0xXX;

Revision Number: 0xXX.

■ Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector
Main board	U90

（15）Fan Speed Monitor Test

■ Test Content

It tests whether the 5 fans inside the system work normally.

■ Test Description

Test results of fan rotational speed will be displayed in the Remark column of the Messages list box, and the format is:

CPU Fan Test PASS/FAIL.
Left Fan(Near Speaker) Test PASS/FAIL.
Left Fan(Middle) Test PASS/FAIL.
Left Fan(Near PC Module) Test PASS/FAIL.
Right Fan Test PASS/FAIL.

■ Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector
Main board	U90

（16）Main Board and Power Module Temperature Test

■ Test Content

Test if the main board and power module temperatures are normal.

■ Test Description

Test results will be displayed in the Remark column of the Messages list box, and the format is:

Main Board temperature test PASS/FAIL(XX.XX C);

Power Board temperature test PASS/FAIL(XX.XX C).

■ Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector
Main board	U90
Main board	Q1
Main power board	Q17

（17）Main Board Voltage Test

■ Test Content

Test if main board voltage is normal.

■ Test Description

Test results will be displayed in the Remark column of the Messages list box, and the format is:

12V power voltage test PASS/FAIL (XX. XX V);
N12V power voltage test PASS/FAIL (XX. XX V);
VCC power voltage test PASS/FAIL (XX. XX V);
VDD power voltage test PASS/FAIL (XX. XX V);
1V5L power voltage test PASS/FAIL (XX. XX V);
D2V8 power voltage test PASS/FAIL (XX. XX V);
D1V8 power voltage test PASS/FAIL (XX. XX V);
VCCINT power voltage test PASS/FAIL (XX. XX V).

■ Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector
Main board	U90

（18）PC Module and MF Interconnection Test

■ Test Content

Test if PC module and MF interconnection is normal.

■ Test Description

Test results will be displayed in the Remark column of the Messages list box, for the main board with the ID as 0x33 (manufacture)/0x32 (development), the test result is:

PC Module and Multifunction FPGA interconnection test PASS/FAIL;

Multifunction FPGA DDR test PASS/FAIL;

Main Board ID: XX.XX.XX.

And for other main boards, the test result is:

PC Module and Multifunction FPGA interconnection test PASS/FAIL;

Main Board ID: XX.XX.XX.

■ Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector
Main board	U75

（19）USB Interface Test

■ Test Content

Test if the four USB Interfaces on the machine and the I/O extend module work normally.

■ Test Description

When started the self-diagnosis, please insert the 4 USB test clamps to the 4 USB ports. If no test clamp is connected, the system pops up the following dialog box.

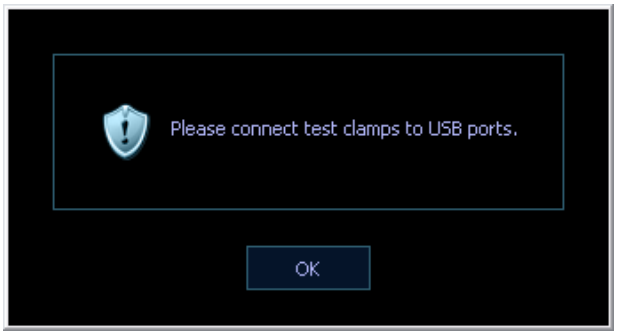


Fig 7-13 Prompt for connecting USB port test clamp

Test results will be displayed in the Remark column of the Messages list box, and the format is:

USB port test PASS

Or,

USB port test FAIL;

USBX…….

■ Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector
Main board	J1
Main board	J13
IO extend module	J1
IO extend module	J6
IO extend module	J7

（20）Svideo Interface Test

- Test Content

It tests whether the function of Svideo Out in the IO extend board is normal.

- Test Description

A display with Svideo interface should be connected to the system during the test.

During the test, the program will output some display content of LCD display to the display device, and pop up a dialog box as shown in the following figure to ask if you can see an image displayed on the display device.

For the main board with ID as 0x33/0x32, the test result is:

The first step: the self-diagnosis program will display the figure as figure below, which is used for testing if S-video output is normal, the output image is PAL-format, with resolution as 800×600.

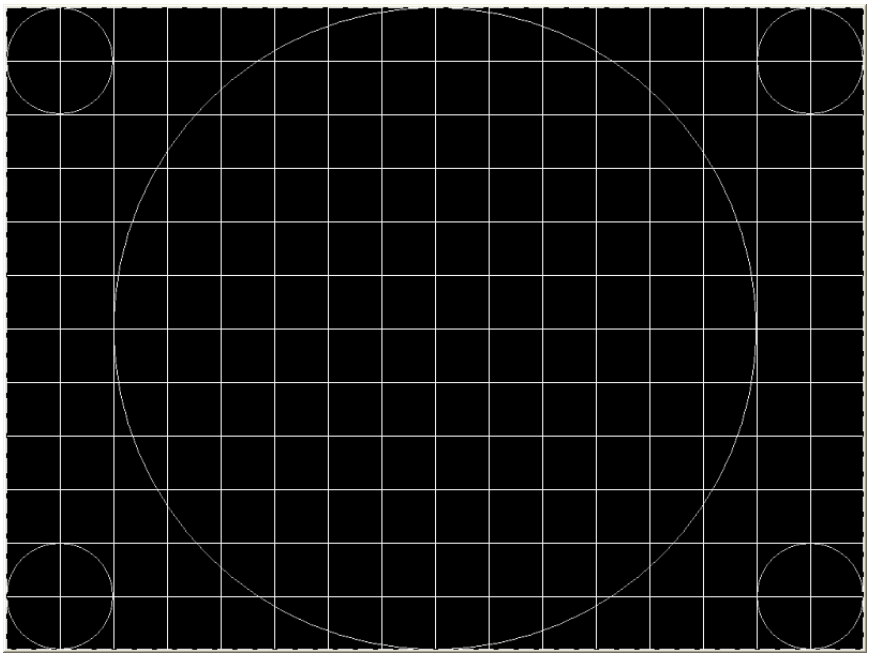


Fig 7-14 PAL-formatted image test (800×600, S-video port)

3 seconds later, a dialogue box pops up as shown in figure below, asking if you can see the image on the monitor. The figure as in figure above is displayed, if correct, click “Yes, I can”; otherwise, click “No，I can’t”.

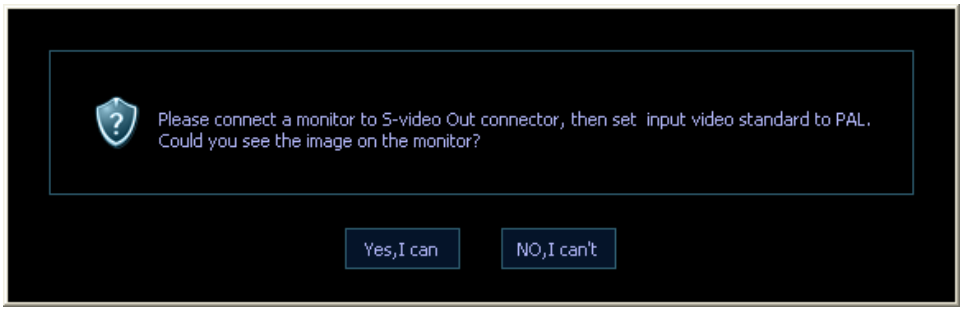

Please connect a monitor to S-video Out connector, then set input video standard to PAL.
Could you see the image on the monitor?
Yes,I can
NO,I can't

Fig 7-15 PAL-formatted image test dialog box

The second step: the self-diagnosis program will display the figure as shown in figure below, which is used for testing if S-video output is normal.

The image format is NTSC, with resolution as 800×600.

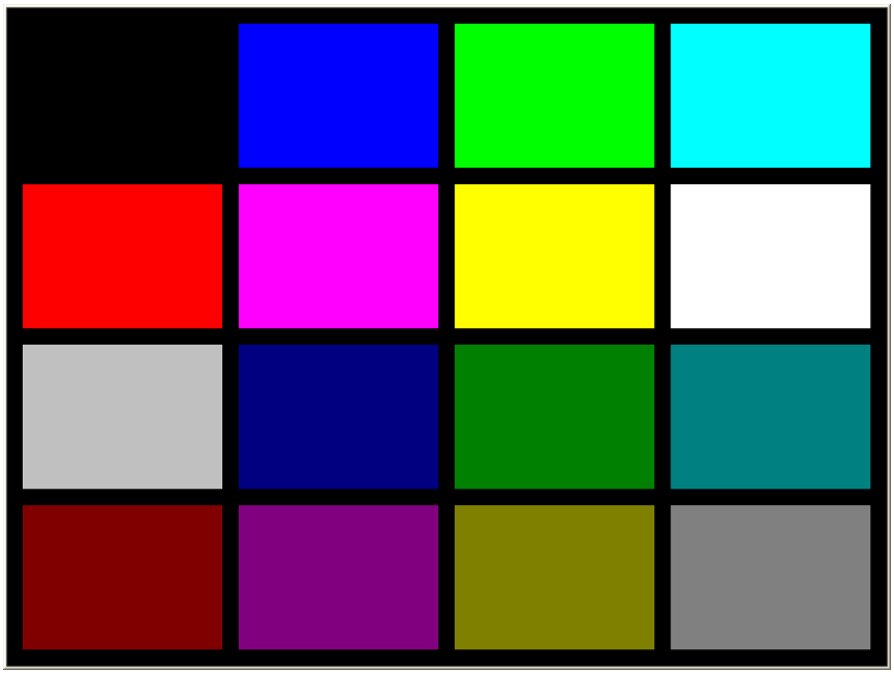


Fig 7-16 NTSC-formatted image test (800×600)

3 seconds later, a dialogue box pops up as shown in figure below, asking if you can see the image on the monitor. The figure as in figure above is displayed, if correct, click “Yes, I can”; otherwise, click “No，I can’t”.

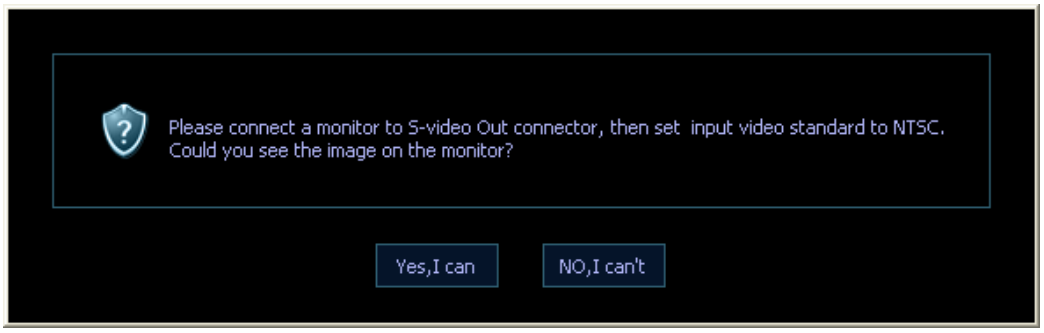

Please connect a monitor to S-video Out connector, then set input video standard to NTSC.
Could you see the image on the monitor?
Yes,I can
NO,I can't

Fig 7-17 NTSC-formatted image test dialog box

The first step: the self-diagnosis program will display the figure as figure below, which is used for testing if S-video output is normal, the output image is NTSC-format, with resolution as 640×480.

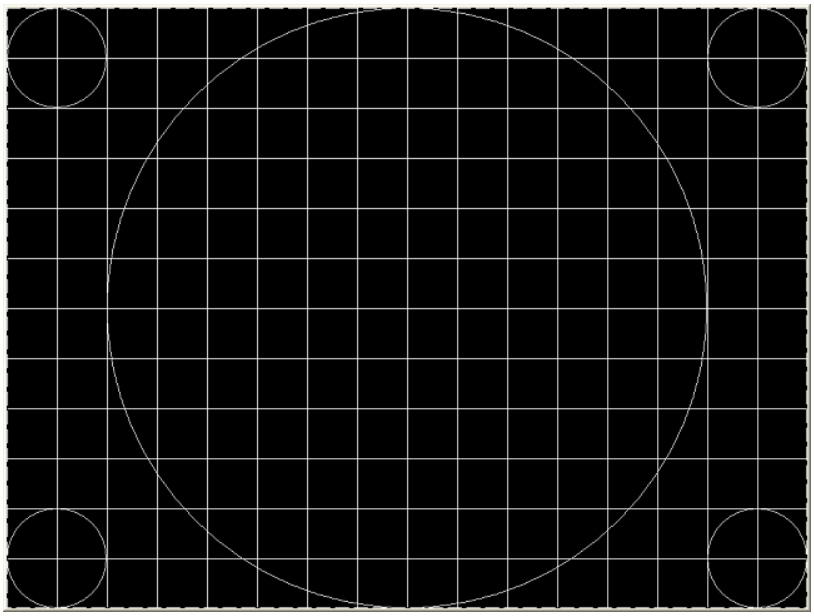


Fig 7-18 NTSC-formatted image test (640×480)

3 seconds later, a dialogue box pops up as shown in Fig 7-17, asking if you can see the image on the monitor. The figure as in figure above is displayed, if correct, click “Yes, I can”; otherwise, click “No，I can’t”.

The first step: the self-diagnosis program will display the figure as figure below, which is used for testing if S-video output is normal, the output image is PAL-formatted, with resolution as 640×480.

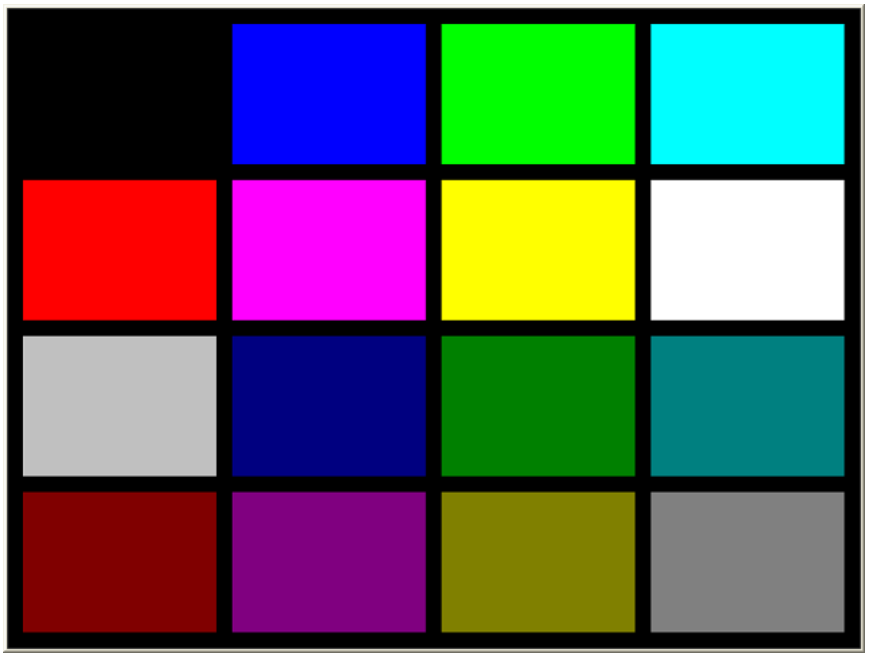


Fig 7-19 PAL-formatted image test (640×480)

3 seconds later, a dialogue box pops up as shown in Fig 7-15, asking if you can see the image on the monitor. The figure as in figure above is displayed, if correct, click “Yes, I can”; otherwise, click “No，I can’t”.

And for main board with ID as 0x33/0x32, the test result is:

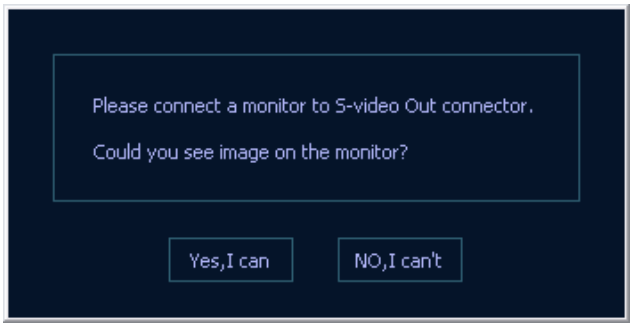


Fig 7-20 S-video Interface Test Dialog Box

If you can see it, click “Yes, I can”; otherwise, click “No, I Can’t”.

Test results will be displayed in the Remark column of the Messages list box, and the format is:

S-video interface test PASS/FAIL.

- Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector
Main board	U75
Main board	U86
Main board	J28

（21）Video Interface Test

- Test Content

It tests whether the function of Video Out in the I/O extend board is normal.

- Test Description

A display with Video interface should be connected to the system during the test.

During the test, the program will output some display content of LCD display to the display device, and pop up a dialog box as shown in the following figure to ask if you can see an image displayed on the monitor.

For the main board with ID as 0x33/0x32, the test result is:

The first step: the self-diagnosis program will display the figure as Fig 7-14, which is used for testing if Video output is normal, the output image is PAL-format, with resolution as 800×600.

3 seconds later, a dialogue box pops up as shown in figure below, asking if you can see the image on the monitor. The figure as in Fig 7-14 is displayed, if correct, click “Yes, I can”; otherwise, click “No，I can’t”.

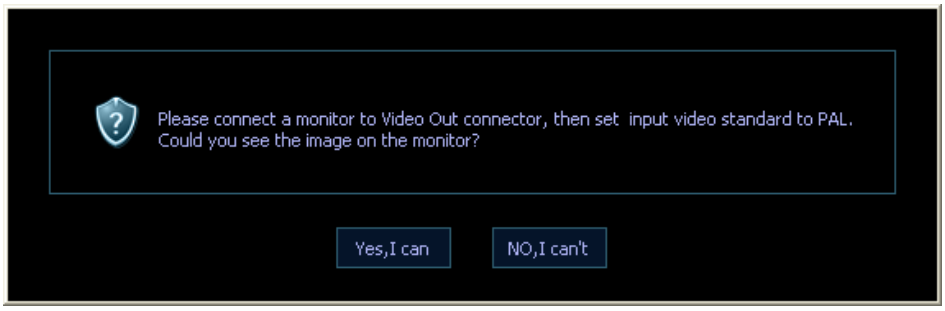

Please connect a monitor to Video Out connector, then set input video standard to PAL.
Could you see the image on the monitor?
Yes,I can
NO,I can't

Fig 7-21 PAL-formatted image test dialog box (Video)

The first step: the self-diagnosis program will display the figure as Fig 7-14, which is used for testing if video output is normal, the output image is PAL-format, with resolution as 800×600.

3 seconds later, a dialogue box pops up as shown in figure below, asking if you can see the image on the monitor. The figure as in Fig 7-16 is displayed, if correct, click “Yes, I can”; otherwise, click “No，I can’t”.

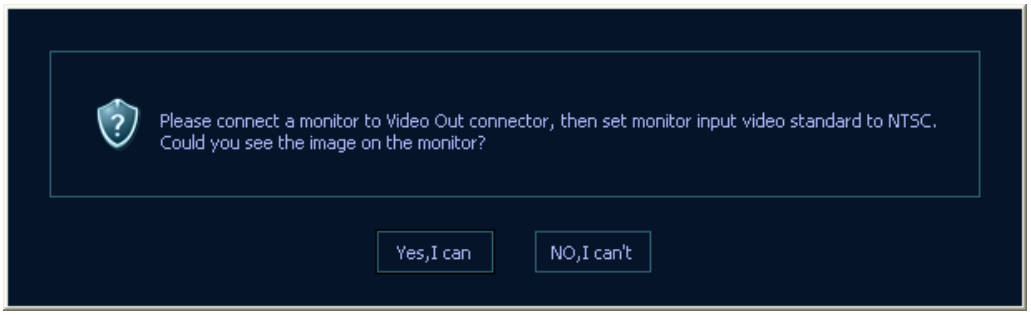

Please connect a monitor to Video Out connector, then set monitor input video standard to NTSC.
Could you see the image on the monitor?
Yes,I can
NO,I can't

Fig 7-22 NTSC-formatted image test dialog box (Video)

The third step: the self-diagnosis program will display the figure as Fig 7-18, which is used for testing if Video output is normal, the output image is NTSC-format, with resolution as 640×480.

3 seconds later, a dialogue box pops up as shown in figure above, asking if you can see the image on the monitor. The figure as in Fig 7-18 is displayed, if correct, click “Yes, I can”; otherwise, click “No，I can’t”.

The first step: the self-diagnosis program will display the figure as Fig 7-19, which is used for testing if S-video output is normal, the output image is PAL-formatted, with resolution as 640×480.

3 seconds later, a dialogue box pops up as shown in Fig 7-21, asking if you can see the image on the monitor. The figure as in Fig 7-19 is displayed, if correct, click “Yes, I can”; otherwise, click “No，I can’t”.

And for other main boards, the test result is:

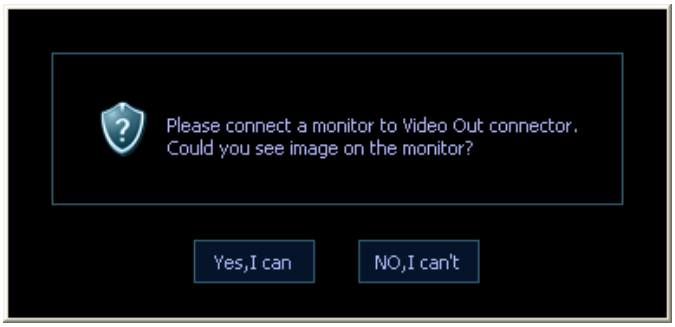


Fig 7-23 Video Interface Test Dialog Box

If you can see it, click “Yes, I can”; otherwise, click “No, I Can’t”.

Test results will be displayed in the Remark column of the Messages list box, and the format is: Video interface test PASS/FAIL.

- Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector
Main board	U75
Main board	U86
Main board	J1
IO extend board	J1
IO extend board	J5

（22）DVI Interface Test

- Test Content

It tests whether the function of DVI Out in the IO extend board is normal.

- Test Description

A display with DVI interface should be connected to the system during the test.

During the test, the program will output some display content of LCD display to the display device, and pop up a dialog box as shown in the following figure to ask if you can see an image displayed on the display device.

Fig 7-24 DVI Interface Test Dialog Box

If you can see it, click “Yes, I can”; otherwise, click “No, I Can’t”.

Test results will be displayed in the Remark column of the Messages list box, and the format is:

DVI interface test PASS/FAIL.

- Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector
Main board	U75
Main board	U76
Main board	J1
IO extend board	J1
IO extend board	J10

（23）VGA Interface Test

- Test Content

It tests whether the function of VGA Out in the IO extend board is normal.

- Test Description

A display with VGA interface should be connected to the system during the test.

During the test, the program will output some display content of LCD display to the display device, and pop up a dialog box as shown in the following figure to ask if you can see an image displayed on the display device.

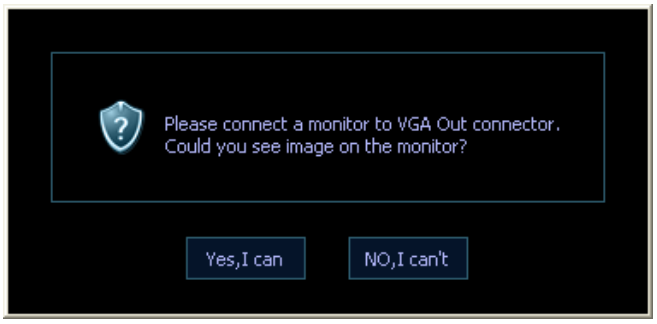


Fig 7-25 VGA Interface Test Dialog Box

If you can see it, click “Yes, I can”; otherwise, click “No, I Can’t”.

Test results will be displayed in the Remark column of the Messages list box, and the format is:

VGA interface test PASS/FAIL.

- Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector
Main board	U75
Main board	U80
IO extend board	J1
IO extend board	J1
IO extend board	J10

（24）Serial Port Test

- Test Content

It tests whether the function of the serial port of the IO extend board is normal.

- Test Description

Short connect pin 2 and pin 3.

Test results of serial port will be displayed in the Remark column of the Messages list box, and the format is:

Serial port test PASS/FAIL.

- Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector
Main board	U75
Main board	U65
Main board	J1
IO extend board	J1
IO extend board	J2

（25）Microphone Interface Test

- Test Content

It tests whether the function of audio chip and MIC port of the IO extend board are normal.

- Test Description

During the test the program shows the following dialog box prompting the user to connect a microphone to the MIC port of the product and speak towards the microphone. The program will detect the sound wave automatically and estimate whether the related circuits of the MIC port work normally.

If sound wave is detected, or any hardware error appeared, the test interface will be shut down in 3 seconds, and no manual operation is required.

If you can see the sound wave, click “OK”. If not, click “Cancel”.

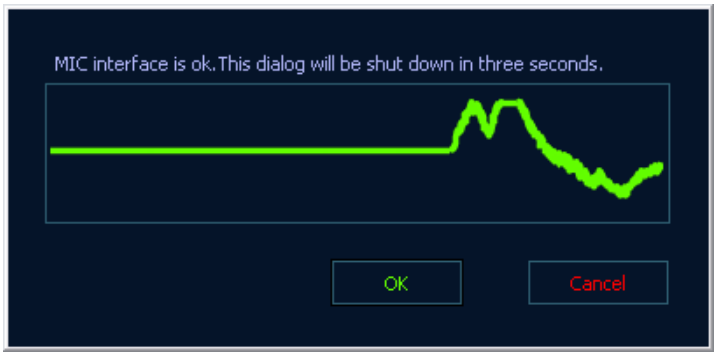


Fig 7-26 Audio Test Dialog Box

Test results will be displayed in the Remark column of the Messages list box, and the format is:

Microphone interface test PASS/FAIL.

- Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector
Main board	U85
Main board	J1
IO extend board	J1
IO extend board	J8

（26）Audio Test

- Test Content

It tests whether the function of audio chip, power amplification circuit and speaker are normal.

- Test Description

During the test, the left side of machine will play out “Ding~~”, and pops up the following dialog box to ask if you can hear “Ding~~” playing out of the left side machine. If you didn’t hear it, please click “Retry” to play it again, and click “No, I Can’t”, if you still can’t hear it after trying many times. And if you heard it, please click “Yes, I Can”.

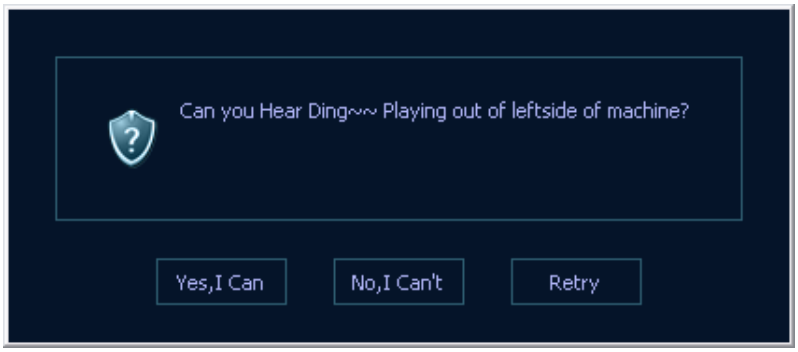


Fig 7-27 Audio Test Dialog Box

The program will control the system right side buzzer to give off “ding…”, and popup the dialog box as shown above. The tests for right and left side buzzers are the same.

Test results will be displayed in the Remark column of the Messages list box, and the format is:

Left Speaker Test PASS/FAIL;

Right Speaker Test PASS/FAIL;

- Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector	Board	Connector
Main board	U85	Main board	U83

Main board	J1	Main board	U84
IO extend board	J1	Main board	J27
IO extend board	J3	Speaker	
IO extend board	J4		

（27）Transducer Interface Test

- Test Content

Test if probe presenting can be recognized, and if communication is normal.

- Test Description

The test flow is shown as follows, please perform the operation according to the workflow strictly.

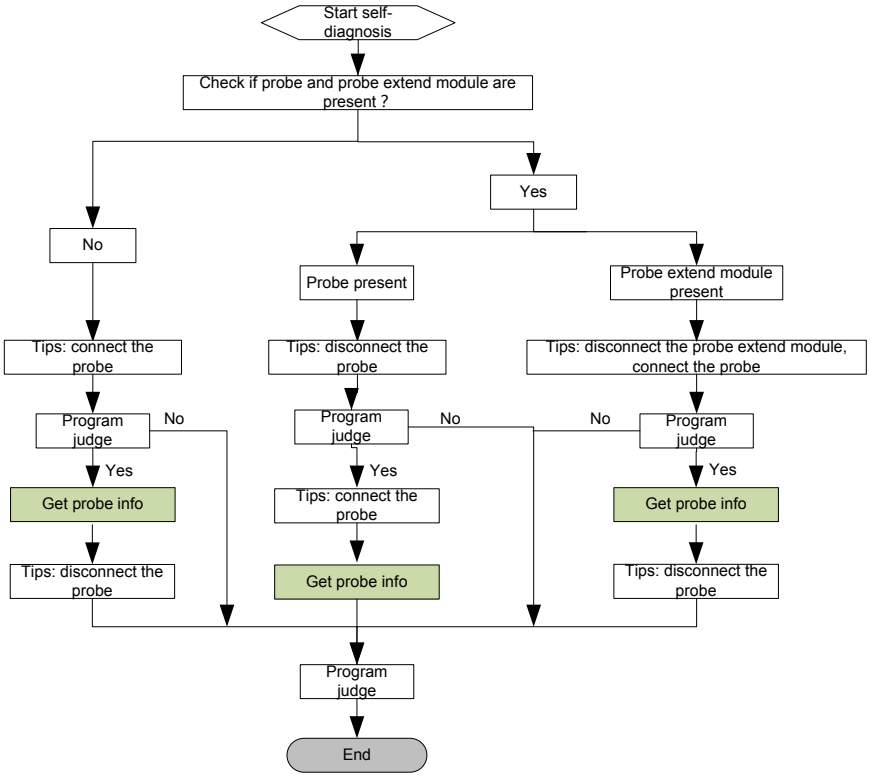


Fig 7-28 Transducer interface test flow

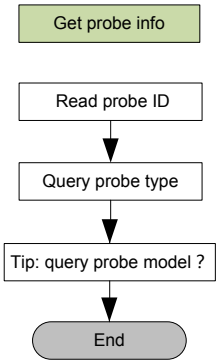


Fig 7-29 Transducer information obtaining flow

The dialog boxes for connecting/disconnecting the transducer, disconnecting the transducer extend module are shown in the figures below respectively.

Fig 7-30 Prompt of Connecting Transducer

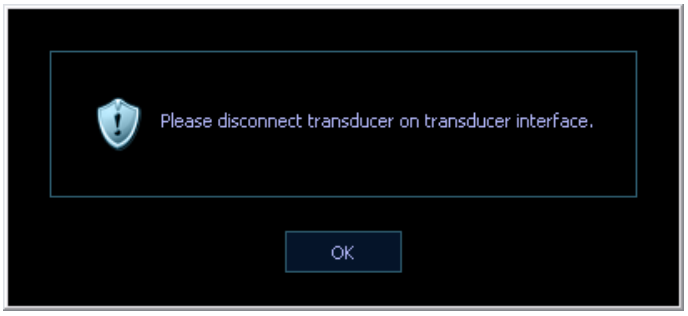


Fig 7-31 Prompt of Disconnecting Transducer

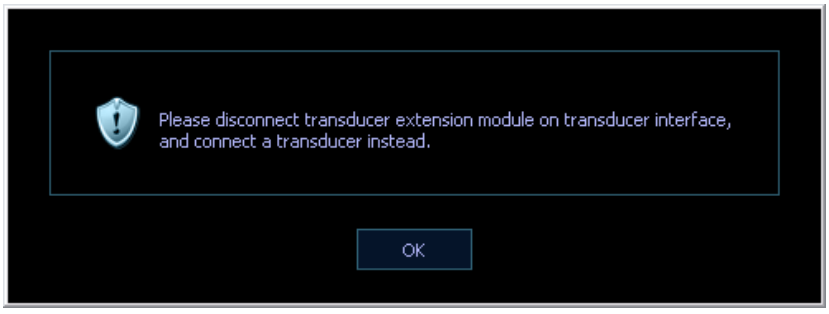


Fig 7-32 Prompt of Disconnecting Transducer Extend Module and Connecting Transducer

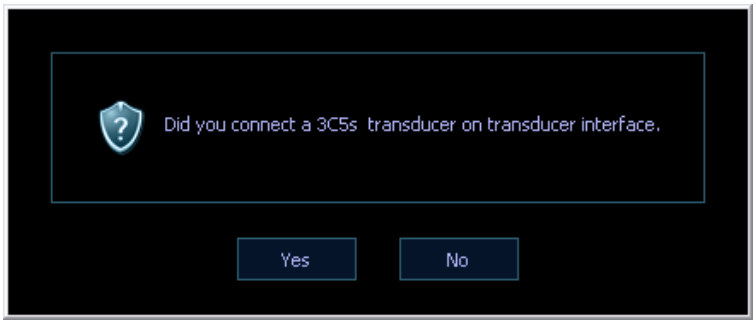


Fig 7-33 Dialogue Box Asking for Transducer Model

Test results will be displayed in the Remark column of the Messages list box, and the format is:

Transducer present test PASS/FAIL;

Transducer interface SPI interconnection test PASS;

Transducer Type: XXXX. Or,

Transducer present test PASS/FAIL;

Transducer interface SPI interconnection test FAIL.

- Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector
Main board	U6
Main board	U10
Main board	J8

（28）Transmission Board and Main Board Interconnection Test

- Test Content

Test if the interconnection between TXFPGA and DSPFPGA work normally.

- Test Description

Test results will be displayed in the Remark column of the Messages list box, and the format is:

Transmission Board and Main Board interconnection test PASS/FAIL.

- Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector
Main board	U6
Main board	J5
Main board	J6
Transmitting board	U3
Transmitting board	J2
Transmitting board	J3

（29）Transmission Board ID and Logic Version Test

- Test Content

Read TX FPGA logic version, logic compilation version, and the compiled time.

- Test Description

Test results will be displayed in the Remark column of the Messages list box, and the format is:

TX FPGA logic version:0xXX;

TX FPGA logic build version:0xXXX;

TX FPGA logic release time: XXXX.XX.XX.

- Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector
Main board	U6
Main board	J5
Main board	J6
Transmitting board	U3
Transmitting board	J2
Transmitting board	J3

（30）MF and Power Module Interconnection Test

- Test Content

Test if communication serial port between MF FPGA and power ARM works normally.

■ Test Description

Test results will be displayed in the Remark column of the Messages list box, and the format is:

Power Board ID:XX;

Power Board firmware version: X.X.

■ Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector
Main board	U75
Main board	U70
Main board	J22
Power board	J1
Power board	U15

（31）Power Module Function Test

■ Test Content

Test if ECG module functions normally.

■ Test Description

Test results will be displayed in the Remark column of the Messages list box, and the format is:

+95V power voltage test PASS/FAIL (+XX.XX V);

-95V power voltage test PASS/FAIL (-XX.XX V).

CW Mode PHV control test PASS/FAIL;

PW Mode PHV control test PASS/FAIL.

■ Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector
Main board	U75
Main board	U70
Main board	J22
Power board	J1

Power board	U15
Power board	U1
Power board	U11

（32）CW Board ID Test(unfinished)

（33）Demodulator and Phase Shifter SPI BUS Function Test(unfinished)

（34）CW Board AD Noise Test(unfinished)

（35）4D Driver Board ID Test

- Test Content

Test if 4D drive board is presenting, and if the devices that record the IDs are normally working.

- Test Description

Test results will be displayed in the Remark column of the Messages list box, and the format is:

4D Driver Board logic version: 0xXX;

4D Driver Board board ID:XX.XX.XX.

- Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector
Main board	U6
Main board	J4
4D Driving Board	U10
4D Driving Board	P2

（36）4D Driver Board Driver Circuit Test

- Test Content

Test if the driving circuit of 4D driver board works normally.

- Test Description

Test results will be displayed in the Remark column of the Messages list box, and the format is:

4D Driver Board driver circuit test PASS/FAIL.

- Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector
Main board	U6
Main board	J4
4D Driving Board	P2
4D Driving Board	U4
4D Driving Board	U6
4D Driving Board	U9
4D Driving Board	U13
4D Driving Board	U14

（37）4D Driver Board Programmable Voltage Test(unfinished)

（38）Left/Right Battery I2C Interconnection Test

- Test Content

Checks if the I2C communication bus between the batteries and the power management ARM works normally.

- Test Description

Test results of left/right battery I2C connection will be displayed in the Remark column of the Messages list box, and the format is:

Left/Right Battery I2C connection test PASS/FAIL.

- Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector
Main board	U75
Main board	U70
Main board	J22
Power board	J1
Power board	U15
Battery	

（39）Left/Right Battery Test

■ Test Content

It tests whether the battery works normally.

■ Test Description

Test results of left/right battery will be displayed in the Remark column of the Messages list box, and the format is:

Left/Right Battery is on site;
Left/Right Battery voltage is: XXXXmV.
Left/Right Battery temperature is: XX.X C.
Left/Right Battery current is: XXXXmA.
Left/Right Battery capacity is: XX%.
Left/Right Battery charge and discharge time is: XXXXX.
Left/Right Battery Safety Status test PASS/FAIL.
Left/Right Battery Permanent Failure Status test PASS/FAIL.

■ Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector
Main board	U75
Main board	U70
Main board	J22
Power board	J1
Power board	U15
Battery	

（40）LCD Monitor ID Test

■ Test Content

Read LCD displayed information.

■ Test Description

Test results will be displayed in the Remark column of the Messages list box, and the format is:

LCD code: 0xXXXXXXXX;
LCD serial number: 0xXXXXXXXX;
LCD version: 0xXX.

■ Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector
Main board	U75

（41）LCD Monitor Brightness Control Test

■ Test Content

It tests whether the adjustment function of LCD backlight is normal.

■ Test Description

During the test, the self-check system will decrease the brightness of the LCD to the lowest and then increase it from the lowest to the highest, and after that the brightness will be decrease from the highest to current value. After this procedure, the following dialog box appears to ask the user whether he/she saw the procedure. If yes, click “Yes, I Can”, otherwise click “No, I Can’t”. If you click “Retry” the system will repeat the procedure above.

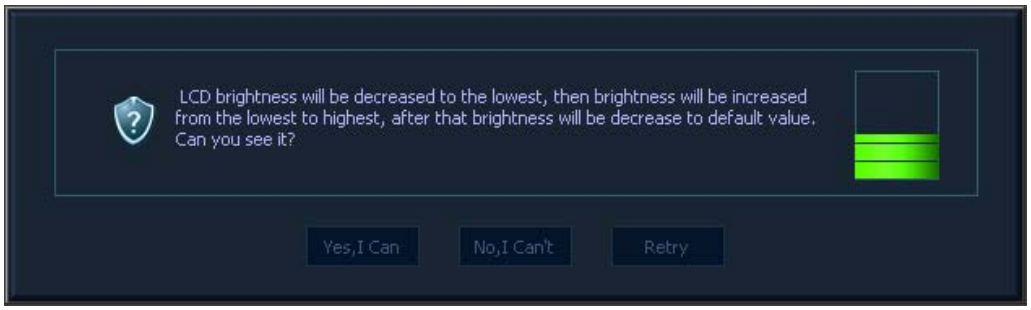

LCD brightness will be decreased to the lowest, then brightness will be increased from the lowest to highest, after that brightness will be decrease to default value. Can you see it?
Yes,I Can
No,I Can't
Retry

Fig 7-34 LCD Brightness Test Dialog Box

■ Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector
Main board	U75

（42）LCD Monitor Backlight Control Test

■ Test Content

It tests whether the switch function of LCD backlight is normal.

■ Test Description

During the test, the self-diagnosis system will switch off the LCD backlight and then switch it on. After this procedure, the following dialog box appears to ask the user whether he/she saw the procedure. If yes, click “Yes, I Can”, otherwise click “No, I Can’t”. If you click “Retry” the system will repeat the procedure above.

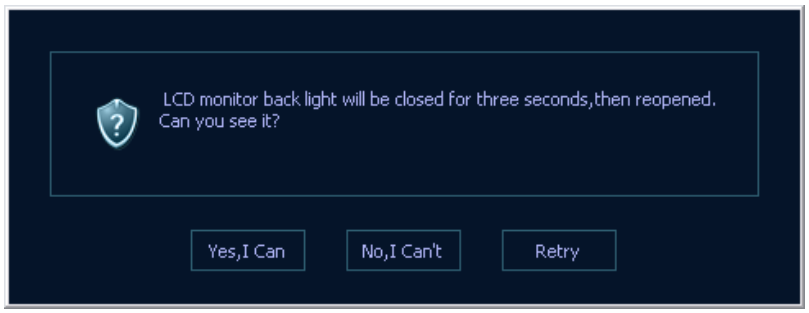


Fig 7-35 LCD Backlight Switch Test Dialog Box

■ Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector
Main board	U75

（43）LCD Monitor Adjust Data Check Test

■ Test Content

Test if LCD monitor adjust data is correct.

■ Test Description

Test results will be displayed in the Remark column of the Messages list box, and the format is:

LCD Monitoradjustdata check test PASS/FAIL.

■ Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector
Main board	U75
Main board	J24
LCD parameter board	U1

LCD parameter board	J1

（44）Keyboard USB Interconnection Test

- Test Content

Test if keyboard and USB port on the main unit can communicate normally.

- Test Description

Test results will be displayed in the Remark column of the Messages list box, and the format is:

Keyboard self test PASS/FAIL.

- Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector
Keyboard board;	U4

（45）Keyboard Key, Encoder, TGC, Trackball Test

- Test Content

It mainly tests whether the buttons, encoders, TGCs, trackball, backlight LEDs and indicating LEDs in the keyboard are normal, and reads board ID, keyboard FPGA and version of program.

- Test Description

The keyboard testing interface is shown as follows:

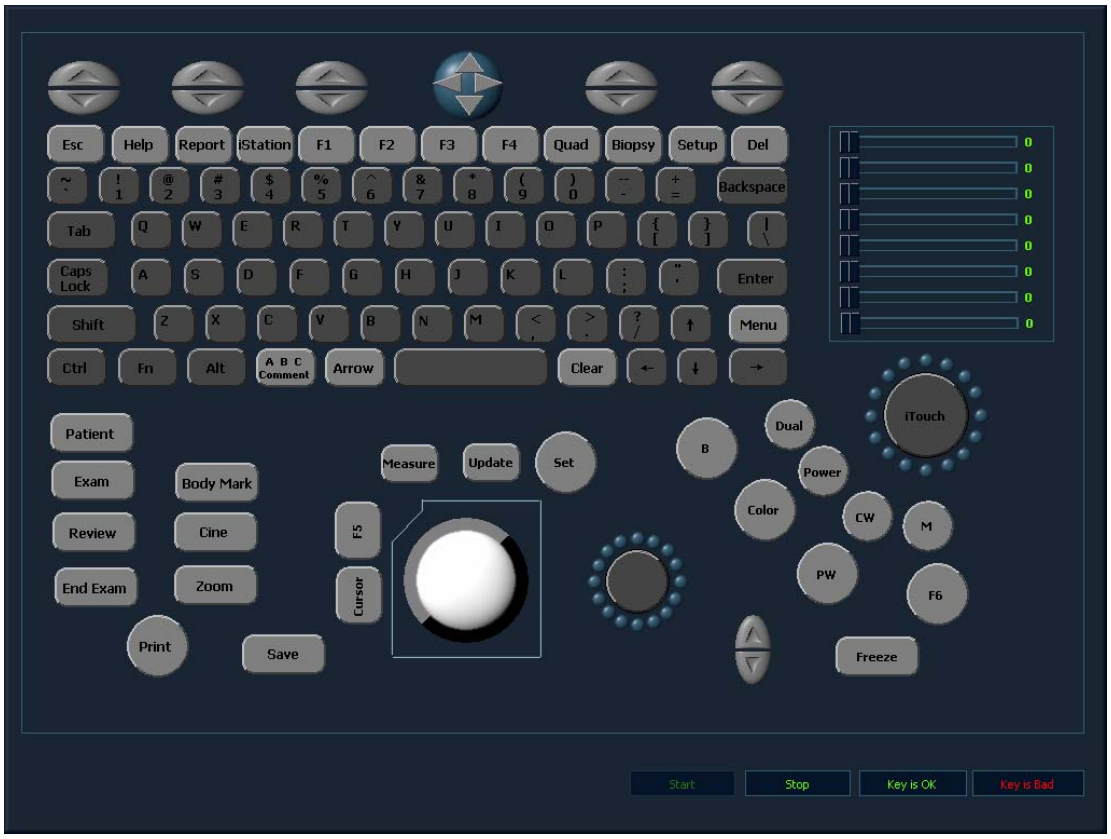


Fig 7-36 Interface of Keyboard Test

As shown in the figure above, click [Start] to start the keyboard test. The controls in the simulation keyboard are corresponding to those of the real keyboard assembly.

As for the buttons, press a button in the real keyboard and the corresponding button in the simulation keyboard blinks, which means the button is being tested. Changing in color means the button has being tested.

As for the trackball, roll the trackball in the keyboard and the cursor in the interface moves accordingly and the in the simulation keyboard blinks, which means the system has received data from the trackball and the trackball has being tested.

The encoder rotation test: the

on the simulation keyboard corresponds to the encoder on the real keyboard. When you rotate the encoder in a direction, the corresponding green ball around the encoder on the simulation keyboard will rotate in the same direction. The encoder face will flicker and turn green.

The encoder key test: when you press the encoder key, the encoder key on the simulation keyboard will change status accordingly, and flicker and turn green.

TGC test: 8 TGC sliders on the keyboard correspond to

controls on the simulation keyboard. When sliding TGC sliders on the keyboard, the corresponding controls on the simulation keyboard will move as well.

Keyboard backlight test: when the simulation keyboard initializes, all dual-color lights will highlight in green on the keyboard. When a key is being tested, the dual-color backlight will automatically turn orange after it is pressed.

After all tests for the keyboard assembly finished, the keyboard screen is shown in Fig 7-37 Keyboard Test Screen after the Test

.

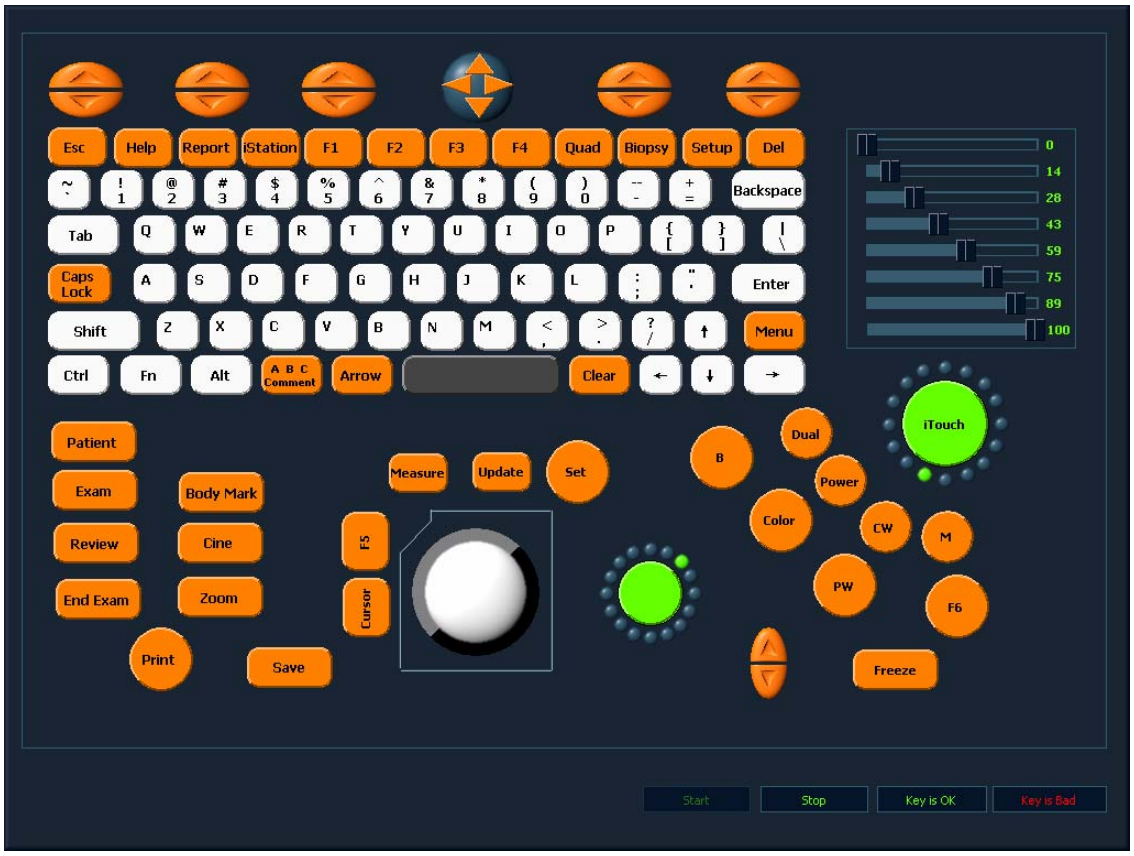


Fig 7-37 Keyboard Test Screen after the Test

After the tests, if functions of the keyboard assembly are normal, click “Keyboard is OK”; otherwise, click “Keyboard is Bad”.

Test results will be displayed in the Remark column of the Messages list box, and the format is:

Keyboard Test PASS/FAIL;

Keyboard ID: XX.XX.XX;

Keyboard FPGA Version: XX.XX;

Application Version: XX.XX.

■ Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector
Key board board	U4
Key board board	U1
Key board board	U6
Key board board	U30

（46）Keyboard Key and Trackball LED Test

■ Test Content

It tests whether the button LEDs and trackball LED in the keyboard work normally.

■ Test Description

The following dialog box appears when testing. Change the brightness of the white and orange LEDs respectively and check whether the brightness of LEDs on the keyboard change accordingly. Change the color of the trackball LED and check whether the LED on the keyboard changes accordingly. If the brightness of the keyboard LEDs and color of the trackball LED are the same as configured, click “LED is OK and Quit” to quit the dialog box. If not, click “LED is not OK and Quit” to quit the dialog box.

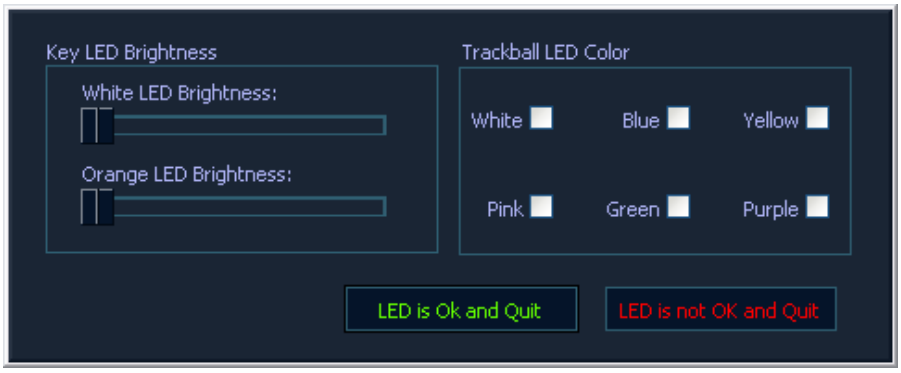


Fig 7-38 Interface of Keyboard LED Test

Test results will be displayed in the Remark column of the Messages list box, and the format is:

Keyboard Key and Trackball LED Test PASS/FAIL.

- Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally

Board	Connector
Key board board	U4
Key board board	U1
Key board board	U6

（47）Extend Module Test

- Test Content

Test if the transducer extend module present can be recognized.

- Test Description

The test flow is shown as follows, please perform the operation according to the workflow strictly.

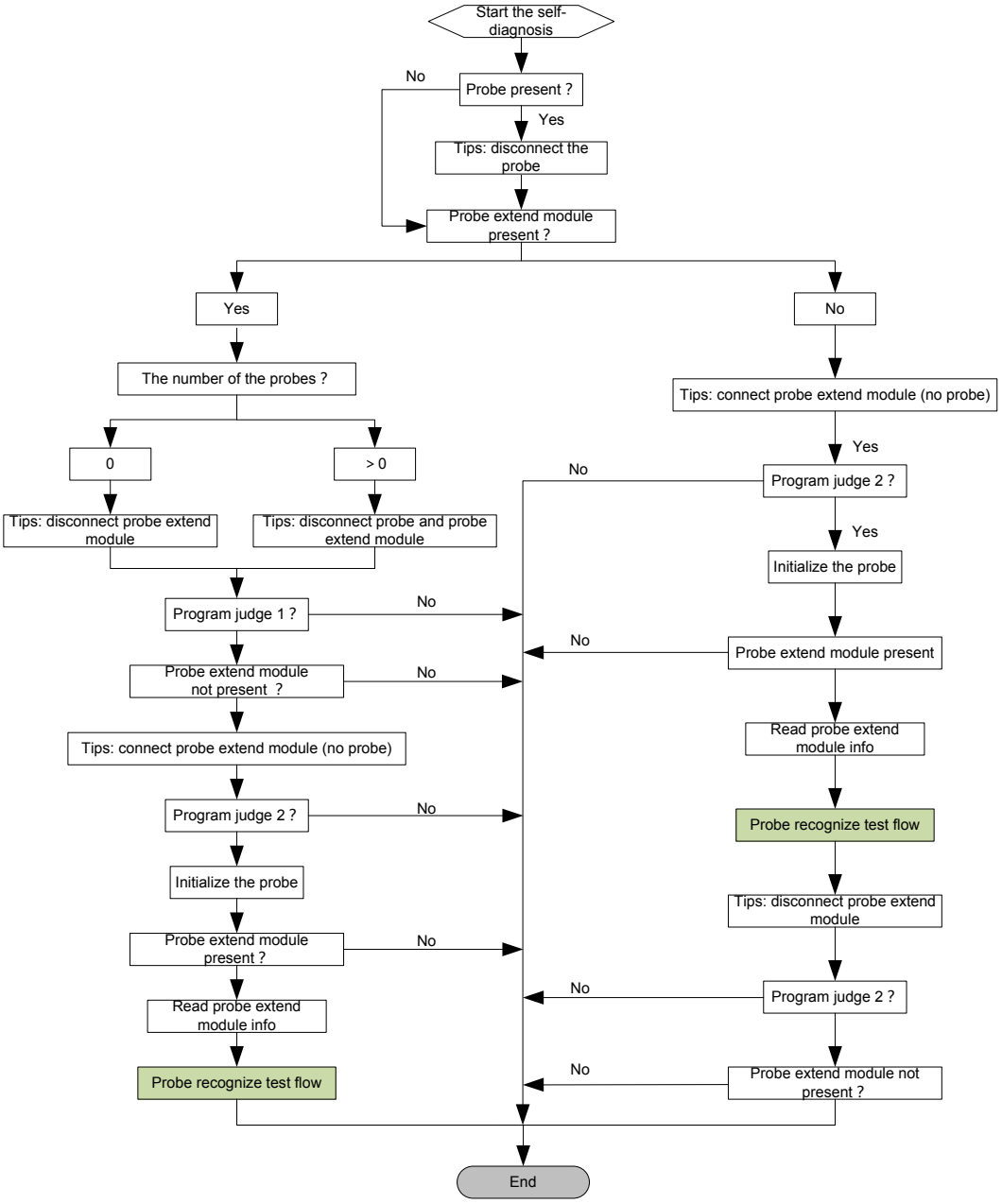


Fig 7-39 Extend Module Test Flow

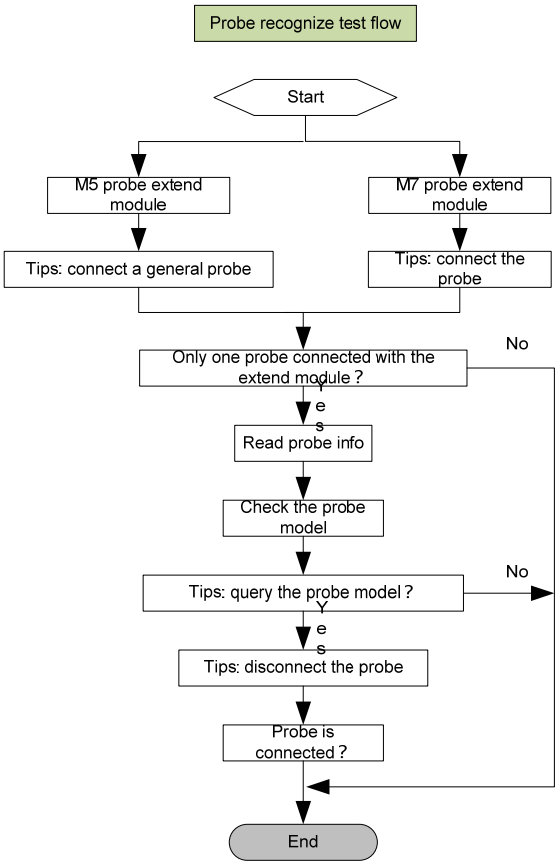


Fig 7-40 Transducer Present Recognize Test Flow

The dialog boxes asking for disconnecting the transducer, connecting/disconnecting the transducer extend module are shown in the figures below respectively.

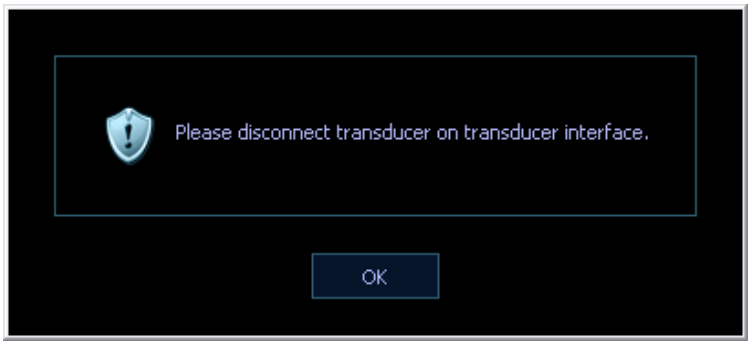


Fig 7-41 Prompt of Disconnecting Transducer

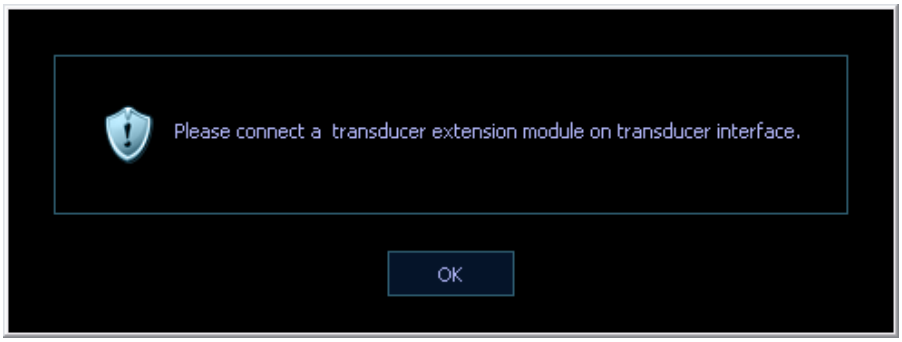


Fig 7-42 Prompt of Connecting Transducer Extend Module

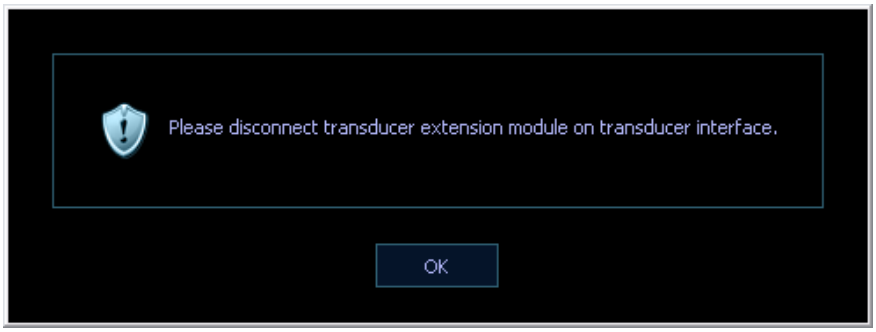


Fig 7-43 Prompt of Disconnecting Transducer Extend Module

Fig 7-44 Prompt for Disconnecting Transducer on Extend Module, and Then Disconnect Extend Module

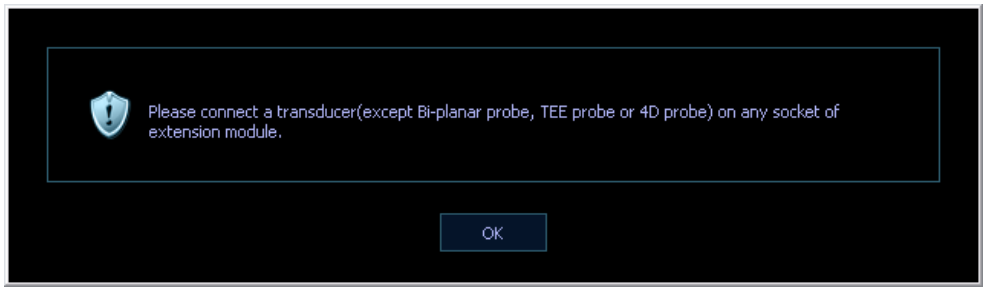


Fig 7-45 Prompt of Connecting General Transducer

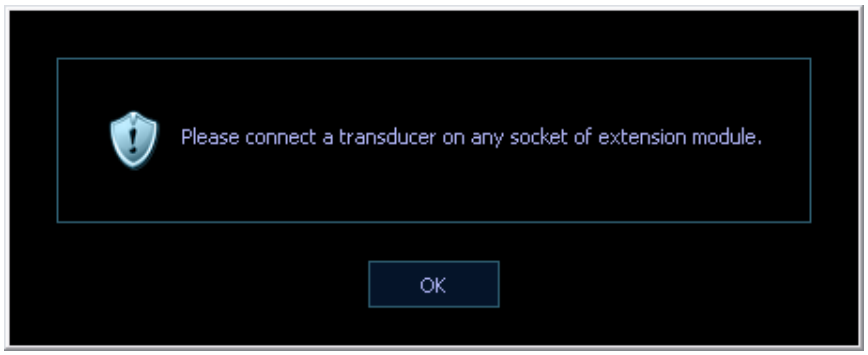


Fig 7-46 Prompt of Connecting Transducer

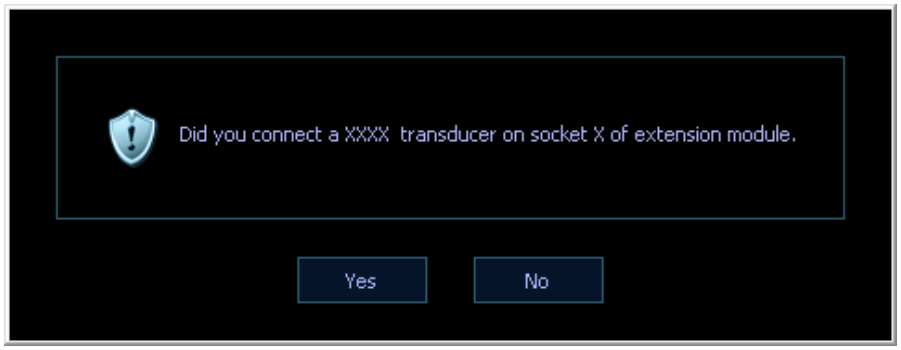


Fig 7-47 Prompt of Asking if the User Connected XXXX Transducer on X Socket

Test results will be displayed in the Remark column of the Messages list box, and the format is:

Transducer Extend Module present test PASS;

Extend Module SPI interconnection test PASS;

Extend Module transducer recognition test PASS;

Board ID: 0xXXXX;

Logic version: 0xXXXX.

Or,

Transducer Extend Module present test FAIL;

Extend Module SPI interconnection test FAIL.

Extend Module transducer recognition test FAIL.

■ Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally.

Board	Connector
Main board	U6

Board	Connector
Main board	U10
Transducer extend module	

（48）ECG Module Information Read Test

■ Test Content

Verify if ECG module communicates well with the main unit, read Bootloader version, board ID and software version.

■ Test Description

After tested is started, if ECG is not presented, then a dialog box is opened to ask the user to connect ECG module, see the figure below:

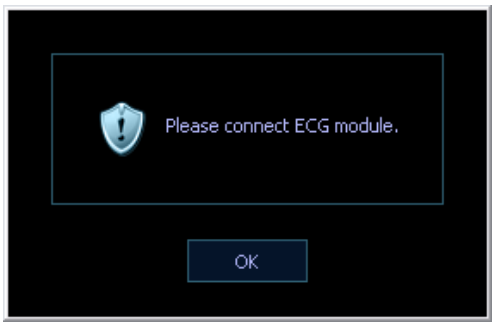


Fig 7-48 Ask the User to Connect ECG Module

Test results will be displayed in the Remark column of the Messages list box, and the format is:

ECG Module information read test PASS;

Bootloader version: XX.XX;

Board ID: %d.XX.XX;

Software version: XX.XX.

Or,

ECG Module information read test FAIL.

■ Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally.

Board	Connector
Main board	U6
Main board	U75

Main board	J1
IO extend module	J1
IO extend module	J11
ECG module	

（49）ECG Module Self Test

■ Test Content

Test if ECG module functions normally.

■ Test Description

After tested is started, if ECG is not presented, then a dialog box is opened to ask the user to connect ECG module, see the figure below:

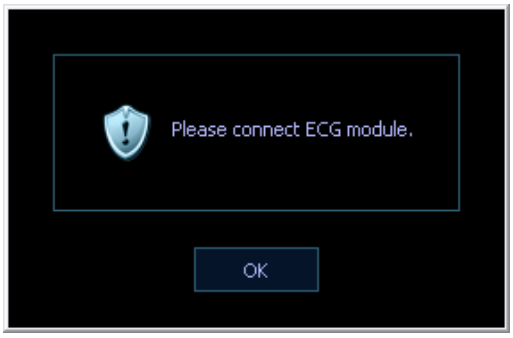


Fig 7-49 Ask the User to Connect ECG Module

Test results will be displayed in the Remark column of the Messages list box, and the format is:

ECG Module self test PASS.

Or,

ECG Module self test FAIL;

XXX,XXX,XXX……

■ Suggestion when test failed:

Check if the following listed hardware and the related circuits are normal, check if the interfaces are well welded and if the module is working normally.

Board	Connector
Main board	U6
Main board	U75
Main board	J1

IO extend module	J1
IO extend module	J11
ECG extend module	

（50）Pencil Probe Present Test(unfinished)

（51）Pencil Probe ID Test(unfinished)

8 Care and Maintenance

8.1 Overview

The following procedures are recommended.

8.1.1 Tools, Measurement Devices and Consumables

Table 8-1 Tools and Measurement Devices

Tool/Measurement Devices	Qty.	Remarks
Resin or plastic container	1 pcs	Can accommodate two probes
Soft brush	1 pcs	About a toothbrush size
Small plastic basin	1 pcs	Used to fill the soapy water
Safety test analyzer	1 pcs	Refer to appendix A
Inner hexagon wrench	2 pcs	Inner hexagon wrench 6

Table 8-2 Consumable List

Consumable	Qty.	Remarks
Aluminum foil	About 1 meter	
Physiological saline	About 1000ml	Filling a half container Immerging the whole probe (referring to appendix A). (concentration 0.85 ～ 0.95%)
Mild soapy water	About 400ml	
Dry soft cloth/cotton cloth	About 5 pcs	

8.1.2 Care and Maintenance Items

Table 8-3 Maintenance Items and Frequency

NO.	Maintain content	Frequency	Method
1.	Clean display	Monthly	Referring to 8.2.1
2.	Clean trackball	Monthly	Same as the above
3.	Clean control panel	Monthly	Same as the above
4.	Clean probes (the head)	Every time after using	Same as the above
5.	Clean probe cable and the surface of connector	Monthly	Same as the above
6.	Clean holders (including probe holder and gel holder)	Monthly	Same as the above
7.	Clean cover	Monthly	Same as the above
8.	Clean peripherals	Monthly	Referring to 8.2.2
9.	Check surface of probe	Daily	Referring to 8.3.1
10.	Check power cable and plug	Monthly	Same as the above
11.	Check battery	Annually	Same as the above
12.	Check function of peripherals and options	Annually	Referring to 8.3.3
13.	Mechanical safety inspection	Annually	Referring to8.3.4
14.	Electrical safety inspection	Annually	Referring to appendix A

8.2 Cleaning

8.2.1 Clean the System

8.2.1.1 Flow of Cleaning

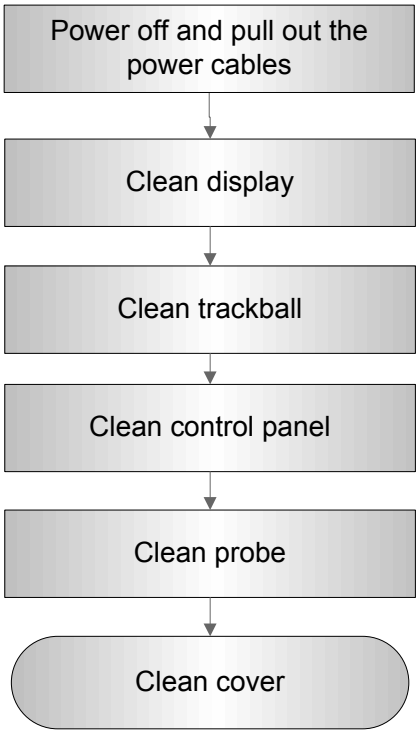


Figure 8-1 **View of Cleaning Maintenance**

> ⚠**WARNING:** **Before cleaning the system, be sure to turn off the power and disconnect the power cord from the outlet. If you clean the system while the power is "On", it may result in electric shock.**

8.2.2 Content

1. Clean Display

- Tool: soft dry cloth ,clear water or mild soapy water
- Method:

  Surface of display should be cleaned with soft dry cloth. Remained stain should be washed out by cloth with clear water or soapy water, and then air-dry the surface.

2. Clean Trackball

- Paper or dry cloth
- Method:

Trackball is one of important interface parts, which are embedded into the main unit keyboard, and part of which is exploded to be operated by users in order to implement variety of module's control

functions. Trackball is one of the most using frequency of input assemblies on the whole operation panel, and the trackball similar to a multi-directory caster can rotate in every direction drived manually, due to the feature, gas or dust can enter into module internal easily, as a result, contamination of lens would lead to the failure of the trackball.

a) Disassembling the trackball:

Turn the trackball ring about 35°counterclockwise until it lifts, now, you would remove the ring and pull out the trackball with plastic cloth if you can't hold it by your hands directly. Disassembling the trackball is as following:

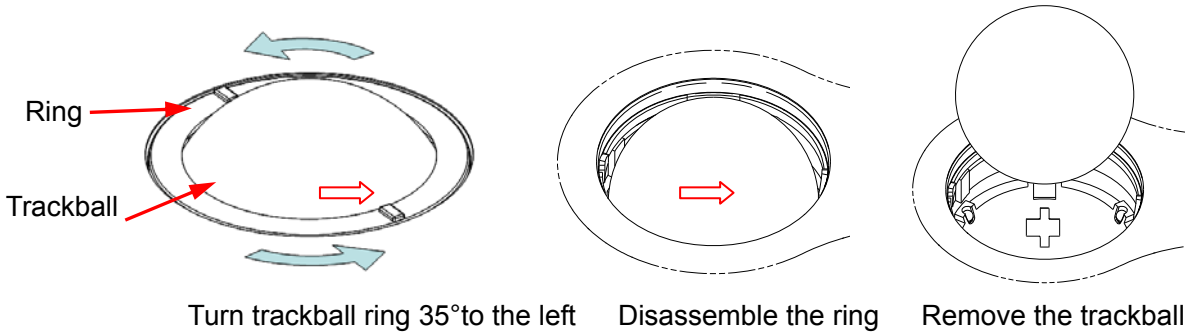


Figure 8-2 Disassembly of the Trackball

a) Cleaning

After removing the ring and the trackball, wipe down the lens with a clean paper until you can see nothing in the groove zoom, and then clean the other contaminant material , please pay attention to your intensity adopted on wiping dust of bead down, as shown in the following figure. Power-off is not need during cleaning, and maintenance effect can be experienced directly. After cleaning completely, you can install the trackball and the ring.

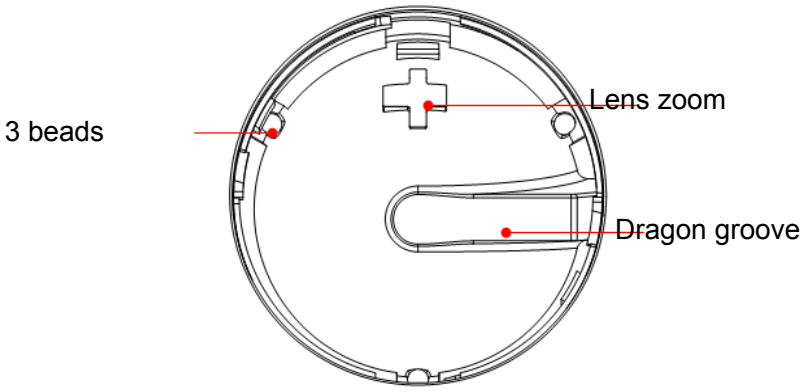


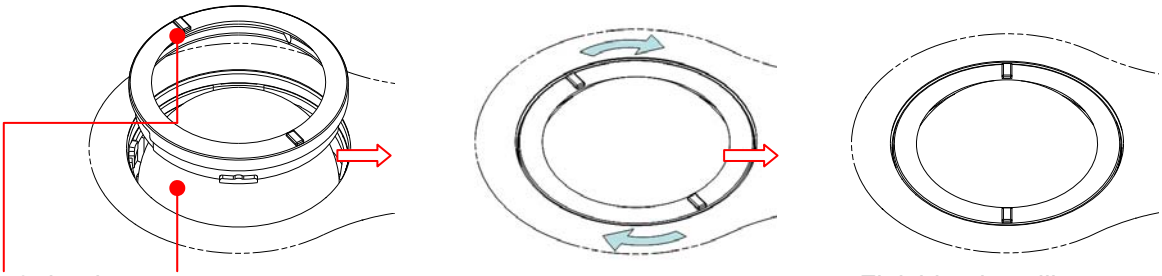
Figure 8-3 The Sketch Map of Len, Bead, Dragon groove

If liquid is accidentally sprayed on or into the system, most of which could discharge from the dragon port of trackball, but some of which would left in the trackball cover, now you may clean it with clean soft dry cloth or paper according to the above maintenance procedure.

b) Installing the trackball

After the trackball maintenance, you can restore the installing following procedure: Put the trackball back in the trackball mechanism and align the clamping ring with the top cover notches. Press the bulges on the ring with both hands and turn the ring about 35° counterclockwise until the ring clicks and locks. As the bulges are flush with the top cover, the ring is secured. See the figure below.

Installing ring



2 ring-buttons Turn 35° to the right after installing Finishing installing

3. Clean control panel

- Tools: dry soft cloth, mild soapy water
- Method:

  Use dry soft cloth to clean the surface of the system. If the system is dirty, moisten the soft cloth with mild soapy water and wipe off any stains. Use dry soft cloth to remove any moisture and allow all hard surfaces to completely air-dry. If it is difficult to clean the control panel, disassemble the keys first and then use mild soapy water to clean it.

NOTE:	Keyboard on the control panel should be cleaned periodically; otherwise, keys maybe blocked by dirt and buzzer dings, keys don't work.

4. Clean Probe

- Tools: mild soapy water , dry soft cloth , soft brush
- Method:

  a) Wipe out the dust attached to surface of probe, and check if it has any abnormality such as crack;

  b) Remained stain or dust attached to surface of probe cable should be washed out by cloth with clear water or soapy water, and then air-dry the surface of probe cable;

  c) Use a soft brush to clean the probe holder, removing dust simultaneously.

5. Clean Cover

- Tools: dry soft cloth, soapy water
- Method:

  Use dry soft cloth to clean the cover of the system. If the system is dirty, moisten the soft cloth with mild soapy water and wipe off any stains, then air-dry.

  Note: Be sure to use soft brush to brush the dust attached to all the sockets or interfaces which can be seen (such as probe sockets, sockets or interfaces in IO panel and power supply panel),not the cloth with water.

8.2.3 Clean the Peripherals

Do the cleaning maintenance according to your actual peripheral configuration; items which are not configured can be skipped.

Table 8-4 Peripherals Cleaning List

No.	Content	Description
1.	Color and B/W video printer	First wipe off dust or stain attached to the cover of printer with soft dry cloth, then clean the inside of printer. Be sure to do the cleaning maintenance according to the operation manual if is necessary.
2.	Graph / text printer	First wipe off dust or stain attached to the cover of printer with soft dry cloth, then clean the inside of printer. Be sure to do the cleaning maintenance according to the operation manual if is necessary.
3.	Foot switch	Use soft dry cloth with a little mild soap water to wipe off the dust or stain attached to the pedals or cable of foot switch.

8.3 Checking

8.3.1 General check

Table 8-5 General check list

No.	Content	Method
1.	Probe	a) Visually check to confirm that there is no crack and expansion to probe head. b) Visually check to confirm that there is no deterioration or desquamation to probe cable. c) Visually check to confirm that there is no bend, destroyed or falling off pins to the connector
2.	Power supply adapter	a) Visually check to confirm that there is no wrinkles, crack or deterioration; No crack and expansion to the surface of adapter. b) Manually check to confirm that there is no looseness or rupture. The connection of plug is reliable.
3.	Battery	Check the battery: a) Check the abnormal information or log of battery and ask abnormal situation in use Operate as follow if necessary: b) Check if battery can be charged normally when power-off: Record one capacity value before power-off, then check the capacity change after period of time when power-on. It takes less than 2 minutes to increase 1% capacity when the total capacity is less than 90% and it takes more time when the capacity is more than 90%. c) Disconnect the system from the AC power supply to confirm if the system can maintain normal work status in the battery power supply.

8.3.2 System Function Check

The system function checking is not required during Preventive Maintenance. Engineer or Customer may use it as part of their product Quality Assurance Program tests。

Table 8-6 System function list

No.	Content	Method
1.	B mode	Verify basic operation of B mode. Check basic software and hardware controls affecting B mode operations.
2.	Color mode	Verify basic operation of Color mode. Check basic software and hardware controls affecting Color mode operations.
3.	Doppler mode (PW/CW)	Verify basic operation of Doppler mode. Check basic software and hardware controls affecting Doppler mode operations.
4.	M mode	Verify basic operation of M mode. Check basic software and hardware controls affecting M mode operations.
5.	Measurement（2D, M, Doppler general measurement, applied measurement optional）	Scanning gray scale imaging on phantom, verify distance and area accuracy with measurement control. Verify measurement accuracy by performance test.
6.	Keyboard test	Operate keyboard test to verify if all control keys can work normally.
7.	LCD	Verify LCD display function and parameters adjustment. Refer to that of LCD checking.
8.	Software menu check	Verify software menu display function: if each operation menu and page can be accessed.
Remark：Please refer to 6.4～6.5 for details.		

8.3.3 Peripherals and Options Check

If the system is not configured with any module or peripheral, the corresponding items checking can be skipped.

Table 8-7 Options, Peripherals and Accessories Check list

No.	Content	Method
1.	Color and B/W video printer	Check if the output of video printer is normal.
2.	Graph / text printer	Check if the output of graph / text printer is normal.
3.	Foot switch	Check if the foot switch can implement the set functions according to the program.
4.	DVD-R/W	Check if DVD can work normally (write, read and pop).
5.	DICOM	Check if DICOM can work normally and send pictures and other data to DICOM server.
Remark：Please refer to 6.3 for details.		

8.3.4 Mechanical Safety Inspection

Mechanical safety inspection is mainly used to check mechanical strength and mechanical function of the key assembly of ultrasonic system. The mode of test evaluation mainly is: Perform the evaluation by means of visual check and operating check, if the check result cannot pass, the system is in abnormal status now. Stop using the system and adopt proper measures. The test flow is as following:

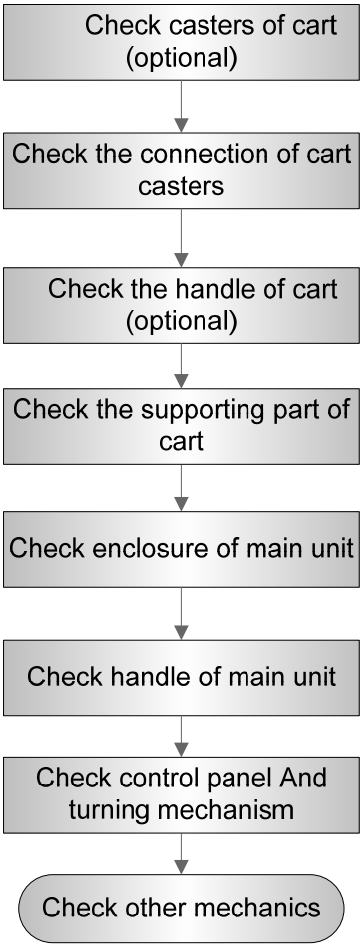

Check casters of cart (optional)
Check the connection of cart casters
Check the handle of cart (optional)
Check the supporting part of cart
Check enclosure of main unit
Check handle of main unit
Check control panel And turning mechanism
Check other mechanics

Fig 8-4 Mechanical Safety Inspection Flow

Table 8-8 Mechanical Safety Check

NO.	Item	Method	Tool
1.	Casters of cart	a) Visually check to confirm there is no any crack. b) Operate the casters to confirm the locking and releasing functions are normal.	none
2.	Connection of cart casters	a) Visually check to confirm that there is no skewness and the connecting screws are free of breakage or falling off. b) Check with the spanner to make sure that there is no looseness between the caster and the base connection screw.	Inner hexagon wrench 6

NO.	Item	Method	Tool
3.	Handle of cart	a) Check by sight if the handle has cracks.	
		b) Use a wrench to check if the handle is loose.	
4.	Cart supporting parts	a) Use hands to check if the supporting parts are loose.	none
5.	Enclosure of main unit	b) Check by sight if there is any crack.	none
6.	Handle	a) Visually check to confirm there is no any crack. b) Rock the handle gently and then lift the ultrasound machine to confirm that the handle is free of looseness and it can accept normal force.	none
7.	Control panel and turning mechanism	Open and close the control panel to see if it is free of looseness or separated from the main unit.	none
8.	Other mechanical structures	Check to confirm that there is no looseness to other mechanical parts, no crack to cover and no conductive parts show in sight.	none

8.3.5 Electrical Safety Inspection

Only technical professionals or engineers after training can perform electric safety inspection.

Please refer to appendix A: Electrical Safety Inspection for details.

9 Troubleshooting of Regular Malfunctions

9.1 Inspection and Repair Work Flow of Power System Failure

9.1.1 Inspection and Repair Work Flow When Powered by Adapter

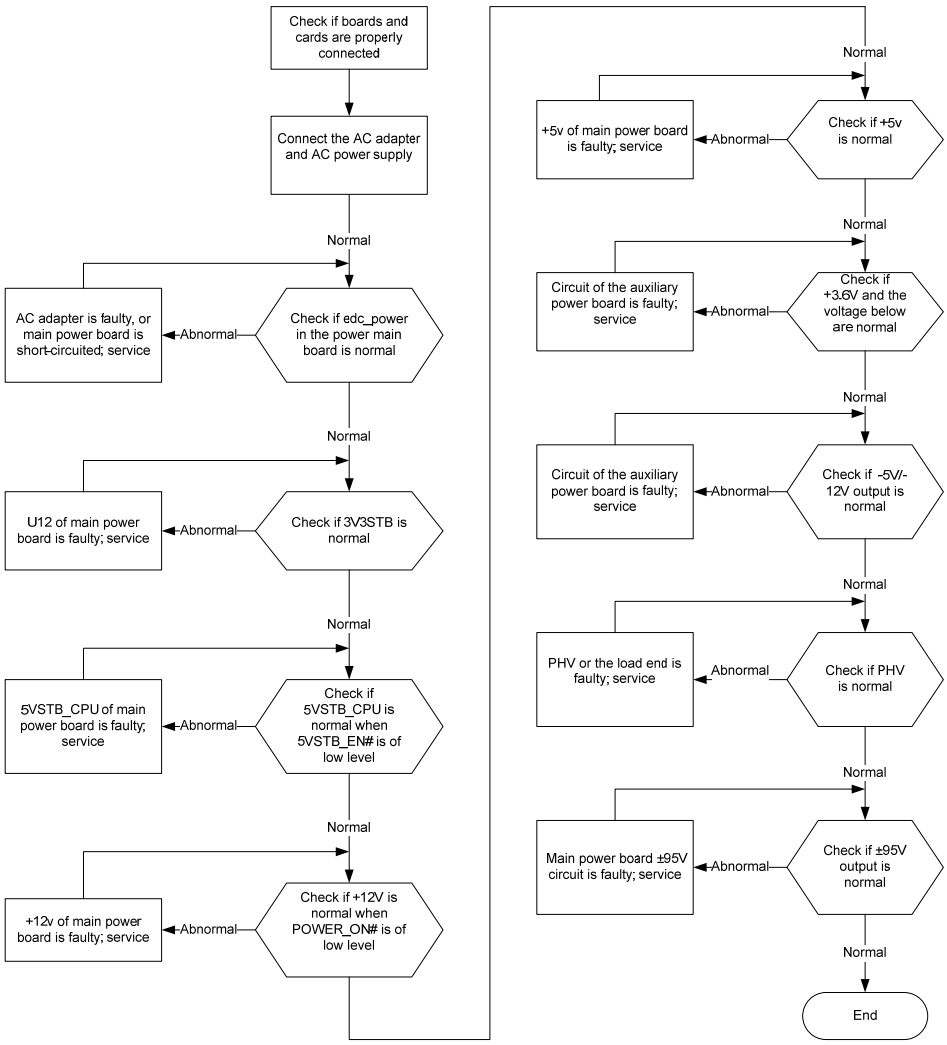

Check if boards and cards are properly connected
Connect the AC adapter and AC power supply
Normal
Check if edc_power in the power main board is normal
Abnormal
AC adapter is faulty, or main power board is short-circuited; service
Normal
Check if 3V3STB is normal
Abnormal
U12 of main power board is faulty; service
Normal
Check if 5VSTB_CPU is normal when 5VSTB_EN# is of low level
Abnormal
5VSTB_CPU of main power board is faulty; service
Normal
Check if +12V is normal when POWER_ON# is of low level
Abnormal
+12v of main power board is faulty; service
Normal
Check if +5v is normal
Abnormal
+5v of main power board is faulty; service
Normal
Check if +3.6V and the voltage below are normal
Abnormal
Circuit of the auxiliary power board is faulty; service
Normal
Check if -5V/-12V output is normal
Abnormal
Circuit of the auxiliary power board is faulty; service
Normal
Check if PHV is normal
Abnormal
PHV or the load end is faulty; service
Normal
Check if ±95V output is normal
Abnormal
Main power board ±95V circuit is faulty; service
Normal
End

Fig 9-1 Inspection and Repair Work Flow when Powered by Adapter

9.1.2 Inspection and Repair Work Flow When Powered by Batteries

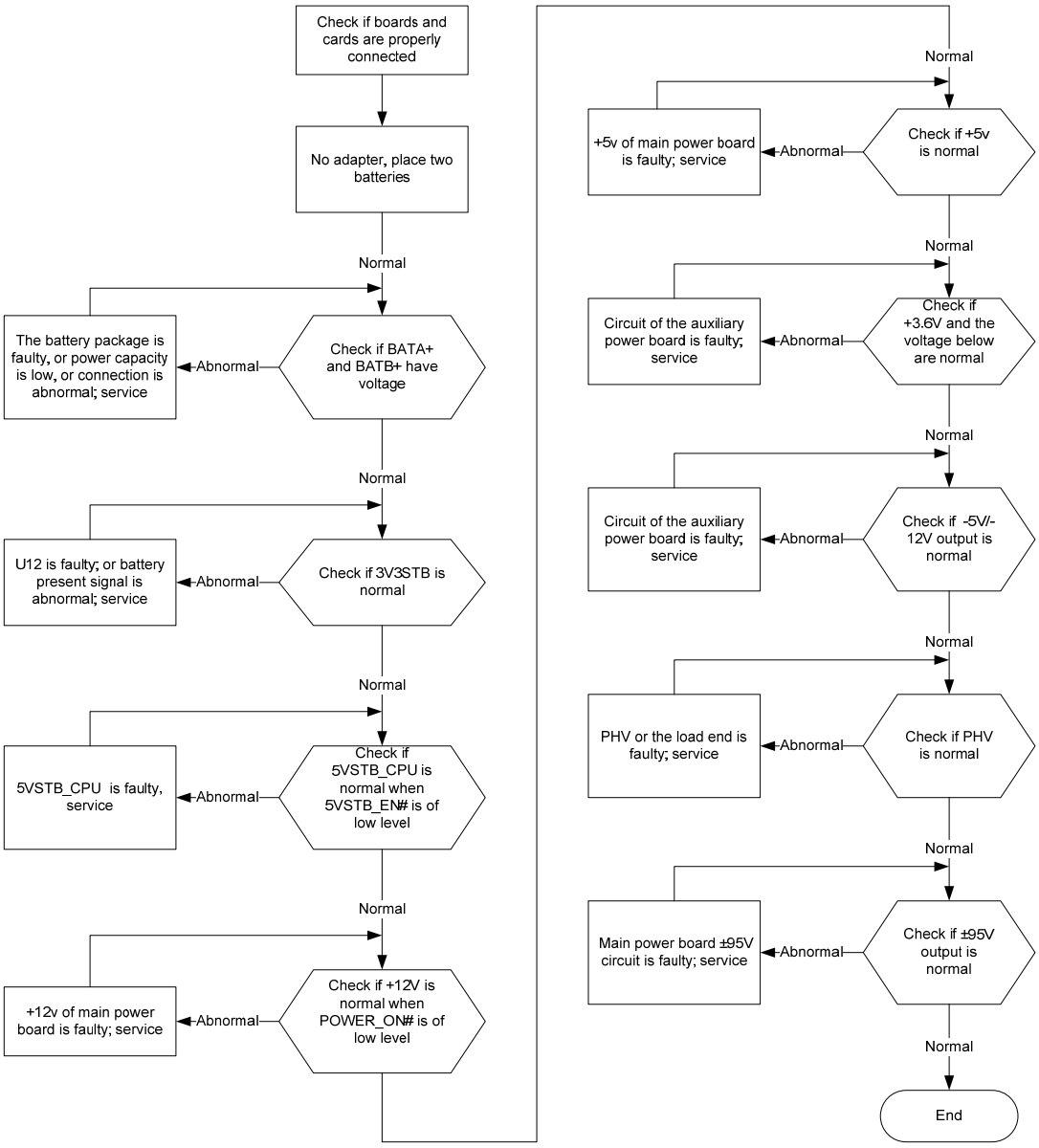

Check if boards and cards are properly connected
No adapter, place two batteries
Normal
Check if BATA+ and BATB+ have voltage
Abnormal
The battery package is faulty, or power capacity is low, or connection is abnormal; service
Normal
Check if 3V3STB is normal
Abnormal
U12 is faulty; or battery present signal is abnormal; service
Normal
Check if 5VSTB_CPU is normal when 5VSTB_EN# is of low level
Abnormal
5VSTB_CPU is faulty, service
Normal
Check if +12V is normal when POWER_ON# is of low level
Abnormal
+12v of main power board is faulty; service
Normal
Check if +5v is normal
Abnormal
+5v of main power board is faulty; service
Normal
Check if +3.6V and the voltage below are normal
Abnormal
Circuit of the auxiliary power board is faulty; service
Normal
Check if -5V/-12V output is normal
Abnormal
Circuit of the auxiliary power board is faulty; service
Normal
Check if PHV is normal
Abnormal
PHV or the load end is faulty; service
Normal
Check if ±95V output is normal
Abnormal
Main power board ±95V circuit is faulty; service
Normal
End

Fig 9-2 Inspection and Repair Work Flow when Powered by Batteries

9.1.3 Inspection and Repair Work Flow of the Charging Unit of the Power System

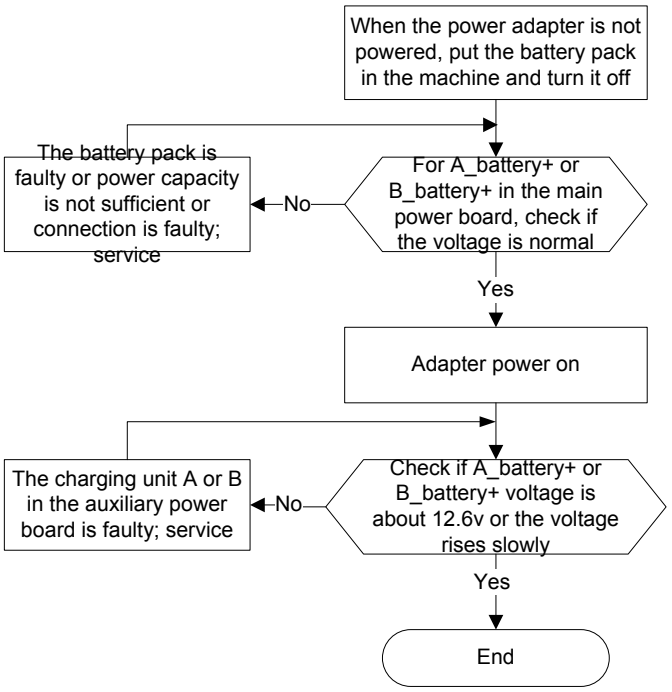

When the power adapter is not powered, put the battery pack in the machine and turn it off
For A_battery+ or B_battery+ in the main power board, check if the voltage is normal
No
The battery pack is faulty or power capacity is not sufficient or connection is faulty; service
Yes
Adapter power on
Check if A_battery+ or B_battery+ voltage is about 12.6v or the voltage rises slowly
No
The charging unit A or B in the auxiliary power board is faulty; service
Yes
End

Fig 9-3 Inspection and Repair Work Flow of the Charging Unit of the Power System

9.2 Location and Repair of System Boot Failure Malfunctions

No.	Failure Description	Failure Analysis	Measure
1	a. The output indicator of the adapter is off when the adapter is not connected to main unit; b. The output indicator of the adapter and the adapter-present indicator of main unit are off when the adapter is connected to main unit; c. There is no response as POWERBTN is pressed when the system is powered by adapter only; the system starts up normally but the status indicator of the batteries is off or blinking in orange when both the adapter and the batteries are connected.	The adapter is damaged.	Replace the adapter.
2	a. The power output indicator is lit up and the	The output voltage of	Replace the

No.	Failure Description	Failure Analysis	Measure
	adapter-present indicator of main unit is off when the adapter is connected to main unit; b. There is no response as POWERBTN is pressed when the system is powered by adapter only; c. The system starts up normally but the status indicator of the batteries is off or blinking in orange when both the adapter and the batteries are connected.	the adapter is lower than 10.8V (low possibility).	adapter.
		The common-mode inductor of main board adapter is open circuit (high possibility).	Replace the main board.
3	a. The output indicator of the adapter is normal; b. All the indicators in the control panel are off; c. There is no response as PWR_BTN is pressed and the system is powered by either adapter or batteries.	The 3V3STB of power module is abnormal (medium possibility).	Replace the power module.
		The 3V3STB of main board is short-circuited (low possibility).	Replace the main board.
		The 5VSTB of power module is abnormal (medium possibility).	Replace the power module.
		The 5VSTB of main board is short-circuited (low possibility).	Replace the main board.
		Power management FPGA is damaged (high possibility).	Replace the main board.
		The 5VSTB of industrial control board is short-circuited (low possibility).	Replace the industrial control board.

No.	Failure Description	Failure Analysis	Measure
4	a. The power output indicator of the adapter is normal when the adapter is not connected to main unit, and the output indicator is off when the adapter is connected to main unit; b. All the indicators in the control panel are off; c. There is no response when PWR_BTN is pressed and the system is powered by either adapter or batteries.	The input segment of the power module is short-circuited.	Replace the power module.
5	a. The output indicator of the adapter is lit up; the adapter-present indicator in the control panel is off; b. The system starts up normally when it is powered by the adapter, but the indicator PWR_BTN in the control panel is off and the indicators related to batteries are displayed normally; c. There is no response as Power_BTN is pressed when the system is powered by batteries.	The 5VSTB_OK# output of power module is abnormal (low possibility)	Replace the power module.
		The reception of 5VSTB_OK# of main board is abnormal (high possibility).	Replace the main board.
6	a. The indicator of the adapter, indicator of quantity of electricity and backlight of Power_BTN are all normal when the system is turned off; b. Press Power_BTN and its backlight first blinks and then lights up continuously. The backlight of control panel is off, the keyboard sound unavailable, fan not working, and LCD, VGA, DVI, Video and S-video displaying nothing;	POWER_ON# of main board is abnormal (high possibility).	Replace the main board.
		The 12V output of power module is abnormal (medium possibility).	Replace the power module.
		The 12V of main board is short-circuited (low possibility).	Replace the main board.
		The 12V of industrial control board is short-circuited (low possibility).	Replace the industrial control board.

No.	Failure Description	Failure Analysis	Measure
7	a. The indicator of the adapter, indicator of quantity of electricity and backlight of Power_BTN are all normal when the system is turned off; b. Press PWR_BTN and its backlight keeps blinking. The backlight of control panel is off, the keyboard sound unavailable, fan not working, and LCD, VGA, DVI, Video and Svideo displaying nothing;	The main board cannot send power-on PWR_BTN to industrial control board (high possibility).	Replace the main board.
		The industrial control board cannot respond PWR_BTN signal normally (low possibility).	Replace the industrial control board.
		The main board cannot S3# signal from the industrial control board (high possibility).	Replace the main board.
8	a. Nothing is wrong when the system is powered by the adapter; b. There is no response as PWR_BTN is pressed when the system is powered by batteries;	Cannot switch to batteries.	Replace the power module.
9	a. Nothing is wrong when the system is powered by batteries; b. The adapter-preset indicator is off and there is no response as PWR_BTN is pressed when only the adapter is connected; c. When both the adapter and batteries are connected, the adapter-present indicator is normal, and the system is actually powered by batteries during startup and running and the quantity of electricity of batteries is being consumed; d. Charging with the system off is available;	Cannot switch to the adapter.	Replace the power module.

No.	Failure Description	Failure Analysis	Measure
10	a. The indicator of the adapter, indicator of quantity of electricity of batteries and backlight of Power_BTN are all normal; b. The backlight of Power_BTN is normal as it is pressed; the backlight first blinks and then keeps on and there is button beep; the fan runs normally and the backlight of control panel is normal; c. Nothing is displayed in LCD, VGA, DVI, Video and Svideo; d. The system can make Doppler; power-off is unavailable by pressing PWR_BTN shortly (power-off is available only by entering Power Off selection and confirming); e. Backlight of LCD can be spotted in dark room;	The 3.3V output of power module is abnormal (high possibility).	Replace the power module.
		The 3.3V of main board is short-circuited (low possibility).	Replace the main board.
11	a. The indicator of the adapter, indicator of quantity of electricity of batteries and backlight of Power_BTN are all normal; b. The backlight of Power_BTN is normal as it is pressed; the backlight first blinks and then keeps on and there is button beep; the fan runs normally and the backlight of control panel is normal; c. Nothing is displayed in LCD and the display of VGA, DVI, Video and Svideo is normal; d. The system can make Doppler; power-off is unavailable by pressing PWR_BTN shortly (power-off is available only by entering Power Off selection and confirming); e. Backlight of LCD can be spotted in dark room;	The 3.3V power supply to LCD of main board is abnormal (high possibility).	Replace the main board.
		LVDS of main board is abnormal (high possibility).	Replace the main board.
		Backlight of LCD is off (high possibility).	Replace the main board.
		LCD is abnormal (low possibility).	Replace the LCD.
		Inverter of LCD is abnormal (low possibility).	Replace the inverter.
12	a. The indicator of the adapter, indicator of quantity of electricity of batteries and backlight of Power_BTN are all normal; blink first and then keep on;	Backlight of LCD is abnormal.	Replace the LCD.

No.	Failure Description	Failure Analysis	Measure
	b. The backlight of Power_BTN is normal as it is pressed; the backlight first blinks and then keeps on and there is button beep; the fan runs normally and the backlight of control panel is normal; c. The display of LCD is not even and the display of VGA, DVI, Video and Svideo is normal; d. The system can make Doppler; power-off is unavailable by pressing PWR_BTN shortly (power-off is available only by entering Power Off selection and confirming); e. Backlight of LCD can be spotted in dark room;		
13	a. The indicator of the adapter, indicator of quantity of electricity of batteries and backlight of Power_BTN are all normal; b. The backlight of Power_BTN is normal as it is pressed; the backlight first blinks and then keeps on and there is button beep; the backlight of control panel is off and the fan runs normally; c. Nothing is displayed in LCD, VGA, DVI, Video and Svideo; d. Backlight of LCD can be spotted in dark room; e. Power-off is unavailable by pressing PWR_BTN shortly;	12VOK of power module is abnormal.	Replace the power module.
14	a. The indicator of the adapter, indicator of quantity of electricity of batteries and backlight of Power_BTN are all normal; b. The backlight of Power_BTN is normal as it is pressed; the backlight first blinks and then keeps on and there is button beep; the backlight of control panel is off and the fan runs normally; c. Nothing is displayed in LCD, VGA, DVI, Video and Svideo; d. Backlight of LCD can be spotted in dark room; e. Power-off is available by pressing PWR_BTN shortly;	The 5V output of power module is abnormal (high possibility).	Replace the power module.
		The 5V of main board is short-circuited (low possibility).	Replace the main board.

No.	Failure Description	Failure Analysis	Measure
15	a. The indicator of the adapter, indicator of quantity of electricity of batteries and backlight of Power_BTN are all normal; b. The backlight of Power_BTN is normal as it is pressed; the backlight first blinks and then keeps on and there is button beep; the backlight of control panel is on and the fan runs normally; c. Nothing is displayed in LCD, VGA, DVI, Video and S-video; d. Backlight of LCD can be spotted in dark room; e. Power-off is unavailable by pressing PWR_BTN shortly;	The processing to 12VOK of main board is abnormal.	Replace the main board.
		The POST of industry control board fails.	Replace the industrial control board.
16	Prompts “Operating system no found” during the startup.	HDD failure	Replace HDD.
		The operating system fails to boot up.	Restore the operating system.

9.3 Location and Repair of Non-echo Failure in Image Region

No.	Failure Description	Failure Analysis	Measure
1	There is no noise image when there is no transducer and the digital gain is maximal.	Something is wrong with AFE of main board (high possibility)	Replace the main board.
		The 3V6 output of power module is abnormal (low possibility)	Replace the power module.
2	a. Connect the transducer, and the system identifies the transducer correctly b. Connect the transducer,	Something is wrong with the programmed voltage of power module (high possibility).	Replace the power module.
		The programmed power of main board is short-circuited (high possibility).	Replace the main board.

No.	Failure Description	Failure Analysis	Measure
	and there is only noise image in non-frozen mode.	The programmed power of transmission board is short-circuited (low possibility).	Replace the Transmission Board
		The fixed high-voltage output of power module is abnormal (high possibility).	Replace the power module.
		The high-voltage switch is abnormal, including the short circuit of power supply (low possibility).	Replace the main board.
		The +/-5V output of power module is abnormal, resulting high-voltage isolation problem (low possibility).	Replace the power module.
		The high-voltage isolation is abnormal, including the short circuit of power supply (low possibility).	Replace the main board.
		Transducer is damaged (low possibility).	Replace the transducer.
3	a. Connect the transducer, and the system identifies the transducer correctly b. Connect the transducer, and there is only noise image in non-frozen mode.	Transducer identification problem of main board (high possibility).	Replace the main board.
		Transducer is damaged (low possibility).	Replace the transducer.

9.4 Location and Repair of the Problem of Image with Black Area

No.	Failure Description	Failure Analysis	Measure
1	There is black area in the noise image when there is no transducer and the digital gain is maximal.	Something is wrong with AFE of main board	Replace the main board.

2	a. The self-diagnosis of front-end channel is passed b. Connect the transducer, and there is black area in non-frozen mode.	The high-voltage switch of main board is abnormal.	Replace the main board.
		The transducer is damaged.	Replace the transducer.
3	a. The self-diagnosis of front-end channel is failed b. Connect the transducer, and there is black area in non-frozen mode.	The transmission and main board are in poor contact.	Pull out and reinsert the transmission board.
		The channel of transmission board is damaged.	Replace the Transmission Board
		The high-voltage isolation is abnormal.	Replace the main board.

9.5 Abnormalities in Image Region

The problems to be solved in this section include abnormalities of B, C, PW and CW images. To solve this problem, replace the power module first to exclude the problems of the power module, then transmission board and at last the main board. If there is analog CW board for CW mode, it should be replaced first.

9.6 Inspection and Repair Work Flow of USB Port Failure

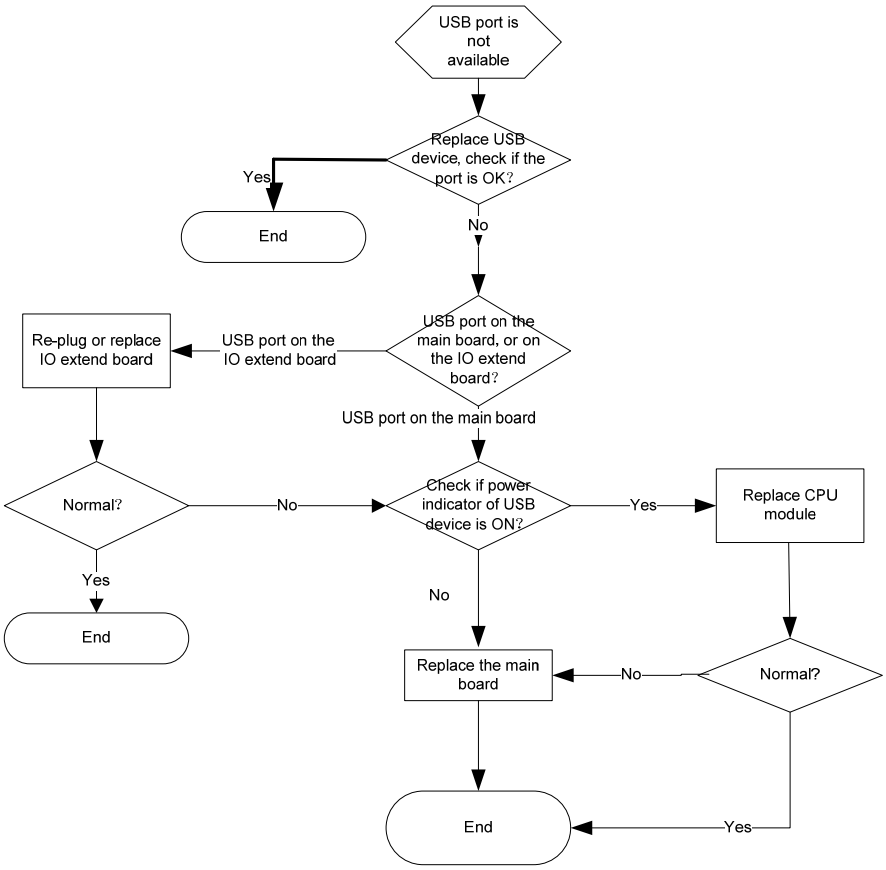


Fig 9-4 Inspection and Repair Work Flow of USB Port Failure

9.7 Inspection and Repair Work Flow of Network Failure

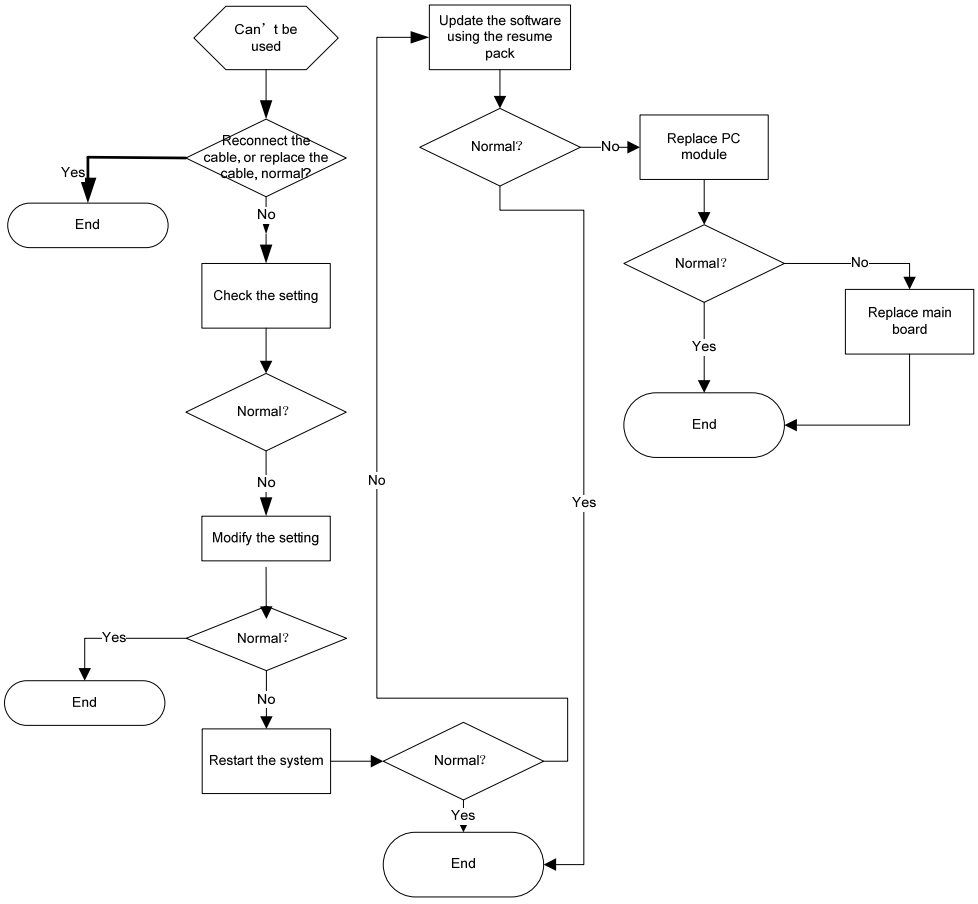


Fig 9-5 Inspection and Repair Work Flow of Network Failure

9.8 Troubleshooting for 4D Board

No.	Failure Description	Failure Analysis	Measure
1	Switch to 4D, and the mechanical scan of the 4D transducer does not begin,	The -12V output of the power module is unavailable.	Test the -12V output of the power module. If the -12V is unavailable, replace the power module;

No.	Failure Description	Failure Analysis	Measure
	namely the electric motor is not working.	The ±(7V~11.5V) of programmed power module of 4D driving board is not available.	(1) Measure whether the voltage of PIN 3 and PIN 5 of U13 (or U4) of 4D driving board are normal. Generally, PIN 3 should be negative (-7V ~ -11.5V), and PIN 5 should be positive (+7V ~ +11.5V). (2) If they are both unavailable, check whether fuse F1 is burnt out. If it is, first check whether the two ends of the fuse are short-circuited to ground and replace the fuse if they are short-circuited. (3) If the fuse is not burnt out, measure whether the +12V voltage of either end of the fuse is normal. If not, the problem is not resulted from the driving board and main board socket, then check the power module. (4) If the problems mentioned in (2) and (3) are all excluded, replace U12 in the 4D driving board.
		The driving signal of the 4D driving board is unavailable.	(1) Measure TP3, TP6 and TP8 with oscillograph, and skip to (2) if they are normal. If no output, measure VDD (PIN 1) and VREF (PIN 5) of U6 with multimeter. If VDD is abnormal, check 3.3V of the main board; if VREF is abnormal, replace U18.If both VDD and VREF are normal, replace DAC U6. (2) Measure TP5 and TP11 with oscillograph. If there are no driving signals, replace U13 and U4; (3) If both TP5 and TP11 are available, measure PIN 8 and PIN 12 of socket P5 of 4D driving board with oscillograph. If there is no output, it means the electric motor inside the transducer is damaged. Replace 4D transducer.
2	Switch to 4D, and the mechanical scan of 4D transducer stops after a few seconds,	Electric motor stops working after started for a few	(1) Check whether there is square wave output in PIN 3 (HALL signal) of socket P5 of 4D driving board during the time when the transducer is working.

No.	Failure Description	Failure Analysis	Measure
	namely the electric motor stops working.	seconds	(2) If not, check whether the 4 driving signals of PIN 1 ~ PIN 8 of socket J1 of transducer connection board are normally output. If normal, skip to (4).If not, check the output of driving signals from the 4D driving board (refer to malfunction 1 and failure analysis 2 for the measurement and solutions) (3) If the driving signals of 4D driving board are normally output, replace the cables. (4) The HALL of 4D transducer is damaged. Replace 4D transducer.

9.9 Troubleshooting for the Keyboard Board

No.	Failure Description	Failure Analysis	Measure
1	Indicator D175 is OFF.	The keyboard cable is pulled out or something is wrong with the keyboard cable. Test TP11, which should be 5V.	Fix the keyboard cable again or replace the keyboard cable.
2	Indicator D176 is OFF.	The keyboard cable is pulled out or something is wrong with the keyboard cable. Test TP21, which should be 12V.	Fix the keyboard cable again or replace the keyboard cable.
3	LED D175 and D176 are lit up normally. The LED D1 of FPGA is not lit up or is blinking. The keyboard board program cannot run normally.	FPGA configuration files haven't been burnt.	Burn FPGA configuration files.
		Make sure the core voltage of FPGA is normal. The voltage of TP17 should be 1.2V.	Replace U20.
		The FLASH is damaged.	Replace U3.
4	TGC value is unstable; even when you don't	Make sure TGC line is connected well (J2)	Fixed

No.	Failure Description	Failure Analysis	Measure
	move the slider, the value varies; the offset between the value and position is great.	The connector of TGC connection wire looses.	Replace TGC connection wire.
5	Some LEDs in boards and cards are not lit up, and the dual-color LEDs are always lit up at the same time.	Check whether the LED soldering direction is correct; check whether the lights are damaged in appearance; check whether the pin of dual-color light is broken circuit.	Solder the component again or replace it.
6	Windows cannot identify the keyboard board (the power of boards and cards is normal, and software and logic are correctly burnt).	No keyboard board driver is installed.	Install the driver.
		The main board connection wire is damaged.	Replace the main board connection wire.
		Test whether USB common-mode inductor L8 is normally conducted.	Replace L8.
		The anti-static chip U5 is damaged.	Replace U5.
		The USB interface chip U4 is damaged.	Replace U4.

9.10 Troubleshooting for ECG Board

No.	Failure Description	Failure Analysis	Measure
1	The corresponding function is unavailable.	The connection between the main unit and the ECG module is abnormal.	Replace the connection cable.
		Power failure	Refer to power failure resolution (Note A)
		The communication of the serial port is abnormal.	Replace U8
2	Open the corresponding function, and the wave form is displayed as a line, or it is abnormal.	ECG lead abnormal	Replace the ECG lead
		The connection between the main unit and the ECG module is abnormal.	Replace the connection cable.

No.	Failure Description	Failure Analysis	Measure
		If the connection cable is normal, open the ECG board and check the indicators D15 and D20 are lit up. If not, it means something is wrong with the power.	Refer to power failure resolution (Note A)
		ECG program abnormal	Rewrite the inferior program of ECG board.
		ECG board abnormal	Replace the ECG board.

Note A. ECG board power failure resolution

When trying to solve power failure, check the power tree of ECG board of 2118 step by step.

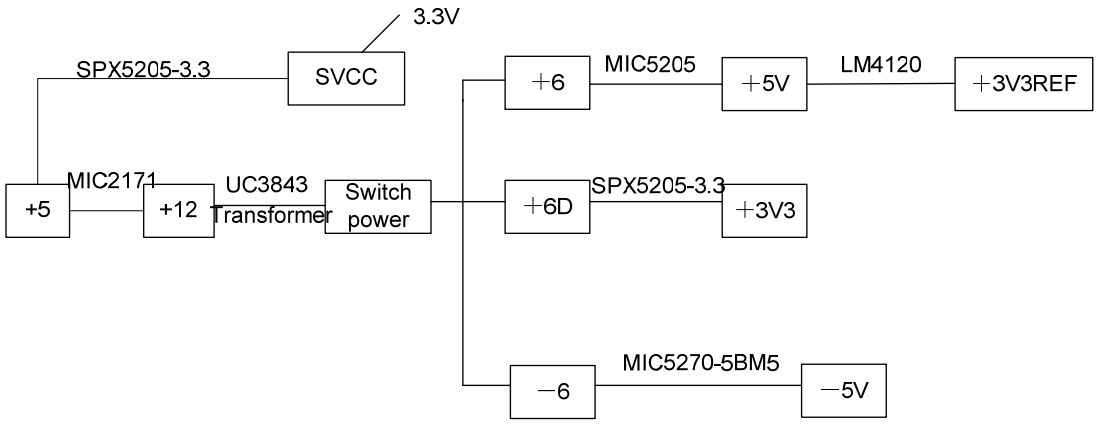


Fig 9-6 Power Tree of ECG Board

The following table lists the relevant information of the test points.

Network Name	Standard Voltage (V)	Voltage Testing Points	Failure Analysis	Failure Resolution
ECG+5V	5±10％	Voltage drop of two ends of C102	Test whether the two ends of F2 are conducted. If not, replace F2.	Replace F2.
＋12V	12±10％	Voltage drop of two ends of C112	Maybe U17 is damaged.	Replace U17.
SVCC	3.3±10％	Testing points of the board	Maybe U23 is damaged	Replace U23

Network Name	Standard Voltage (V)	Voltage Testing Points	Failure Analysis	Failure Resolution
ECG+5V	5±10%	Voltage drop of two ends of C102	Test whether the two ends of F2 are conducted. If not, replace F2.	Replace F2.
＋6V， ＋6D	6±10%	Testing points of the board	Test whether T1 primary or secondary coil is broken circuit. If it is, replace TI. Otherwise, Q1 or U18 may be faulty.	Replace T1, Q1, orU18
－6V	-6±10%	Testing points of the board		
＋5V	5±5%	Testing points of the board	Maybe U22 is damaged	Replace U22
＋3V3	3.3±5%	Testing points of the board	Maybe U24 is damaged	Replace U24
＋ 3V3REF	3.3±5%	Testing points of the board	Maybe U19 is damaged	Replace U19
－5V	-5±5%	Testing points of the board	Maybe U25 is damaged	Replace U25

9.11 Troubleshooting for Video & Audio Capture Card

No.	Failure Description	Failure Analysis	Measure
1	After the video capture card is connected, the screen prompts that the surge occurs or the current is not enough.	USB port cannot provide sufficient power to drive the video capture card.	Replace the main board.
2	After the video capture card is connected, the screen doesn’t display images.	USB cable is not secured.	Reconnect the USB cable.
		The chip is damaged.	Replace the chip.

No.	Failure Description	Failure Analysis	Measure
3	The image is not continuous or some image frames are missing or discolored.	The signal cable is in bad contact, e.g. SVIDEO signal cable is in bad contact or USB signal cable is in bad contact.	Change cable or change the socket.
4	After the video capture card is connected, clicking the capture command cannot normally capture sound.	The installation of the driver isn't correct.	Reinstall the driver.
		Check if the audio input signal rule is specified in the capture software.	Specify it in the software.
		Check if there is BCLK signal, if not, it indicates EMP202 chip is damaged.	Replace the chip.
6	Only part of the source video can be seen.	The video displayed by capture card is of 640*480 resolution. If resolution is not correct, the display will be abnormal.	/

Appendix A Electrical Safety Inspection

The following electrical safety tests are recommended as part of a comprehensive preventive maintenance program. They are a proven means of detecting abnormalities that, if undetected, could prove dangerous to either the patient or the operator. Additional tests may be required according to local regulations.

All tests can be performed using commercially available safety analyzer test equipment. These procedures assume the use of a 601PRO$_{XL}$ International Safety Analyzer or equivalent safety analyzer. Other popular testers complying with IEC 60601-1 used in Europe such as Fluke, Metron, or Gerb may require modifications to the procedure. Follow the instructions of the analyzer manufacturer.

The consistent use of a safety analyzer as a routine step in closing a repair or upgrade is emphasized as a mandatory step if an approved agency status is to be maintained. The safety analyzer also proves to be an excellent troubleshooting tool to detect abnormalities of line voltage and grounding, as well as total current loads.

ELECTRICAL SAFETY INSPECTION

1- Power Cord Plug

TEST PROCEDURE	
◆The Power Plug	
The Power Plug Pins	No broken or bent pin. No discolored pins.
The Plug Body	No physical damage to the plug body.
The Strain Relief	No physical damage to the strain relief. No plug warmth for device in use.
The Power Plug	No loose connections.
◆The Power Cord	
The Power Cord	No physical damage to the cord. No deterioration to the cord. --For devices with detachable power cords, inspect the connection at the device. --For devices with non-detachable power cords, inspect the strain relief at the device.

ELECTRICAL SAFETY INSPECTION

2- Device Enclosure And Accessories

TEST PROCEDURE	
◆Visual Inspection	
The Enclosure and Accessories	No physical damage to the enclosure and accessories.
	No physical damage to meters, switches, connectors, etc.
	No residue of fluid spillage (e.g., water, coffee, chemicals, etc.).
	No physical damage to probe head (e.g., crack)
	No loose or missing parts (e.g., knobs, dials, terminals, etc.).
◆Contextual Inspection	
The Enclosure and Accessories	No unusual noises (e.g., a rattle inside the case).
	No unusual smells (e.g., burning or smoky smells, particularly from ventilation holes).
	No taped notes that may suggest device deficiencies or operator concerns.

ELECTRICAL SAFETY INSPECTION

3- Device Labeling

TEST PROCEDURE

Check the labels provided by the manufacturer or the healthcare facility is present and legible.

- *Main Unit* Label
- *Integrated Warning* Labels
- *Slope and High Voltage Caution* Label
- *Don't Stress* Label

ELECTRICAL SAFETY INSPECTION

5- Earth Leakage Test

OVERVIEW

Run an Earth Leakage test on the device being tested before performing any other leakage tests.

Leakage current is measured the following ways:

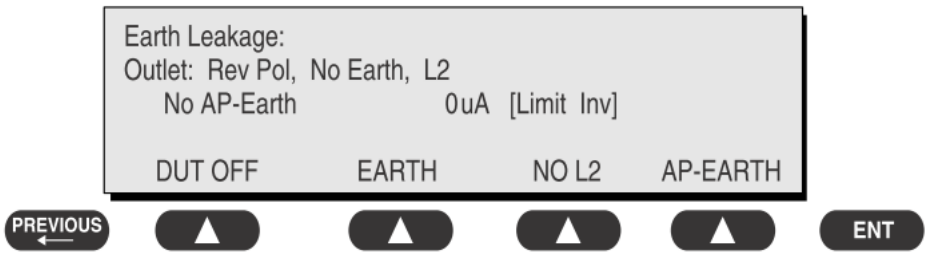
- Earth Leakage Current, leakage current measured through DUT outlet Earth
- Earth Leakage Current AP-EARTH (ALL Applied Parts connected to Earth), leakage current measured through DUT outlet Earth

There is no need to attach a test lead; the 601PRO automatically connects the measuring device internally.

TEST PROCEDURE

◆Perform the Test

1) From the MAIN MENU, or with the outlet unpowered, plug the DUT into the 601PRO front panel outlet, and turn on the device.
2) Attach the device's applied parts to the 601PRO applied part terminals if applicable.
3) Press shortcut key 4.The Earth Leakage test appears on the display, and the test begins immediately:



- SOFT KEY 1 toggles the DUT outlet Polarity from Normal to Off to Reverse.
- SOFT KEY 2 toggles the DUT outlet from Earth to No Earth.
- SOFT KEY 3 toggles the DUT outlet from L2 to No L2.
- SOFT KEY 4 toggles the AP to Earth to No AP to Earth.

4) Press the print data key at any time to generate a printout of the latest measurement.

ELECTRICAL SAFETY INSPECTION

5- Earth Leakage Test

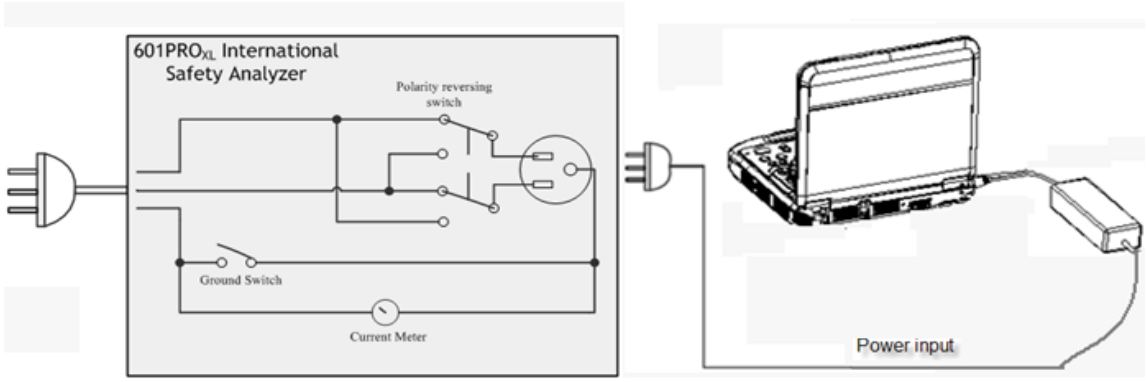


Figure 1 Earth leakage test

◆Failure

Check any short-circuits of the Y capacitor on power unit. Replace a new one if any portion defective.

Check any broken of the Power Unit. Replace a new one if any portion defective.

Inspect mains wiring for bad crimps, poor connections, or damage.

Test the wall outlet; verify it is grounded and is free of other wiring abnormalities. Notify the user or owner to correct any deviations. As a work around, check the other outlets to see if they could be used instead.

Change another probe to confirm if the fail is caused by console.

Inspect mains wiring for bad crimps, poor connections, or damage.

If the leakage current measurement tests fail on a new unit and if situation cannot be corrected, submit a Safety Failure Report to document the system problem. Remove unit from operation.

If all else fails, stop using and inform the Customer Service Engineer for analysis and disposal.

LIMITS

UL60601-1：300 μA Normal Condition

1000 μA Single Fault Condition

IEC60601-1： 500 μA Normal Condition

1000 μA Single Fault Condition

ELECTRICAL SAFETY INSPECTION

6- Patient Leakage Current

OVERVIEW

Patient leakage currents are measured between a selected applied part and mains earth.

TEST PROCEDURE

◆Prepare

Perform a calibration from the Mains on Applied Part menu.

The following outlet conditions apply when performing this test:

Normal Polarity, Earth Open, Outlet ON	Normal Polarity, Outlet ON
Normal Polarity, L2 Open, Outlet ON	Reversed Polarity, Outlet ON
Reversed Polarity, Earth Open, Outlet ON	Reversed Polarity, L2 Open, Outlet ON

◆ Warning

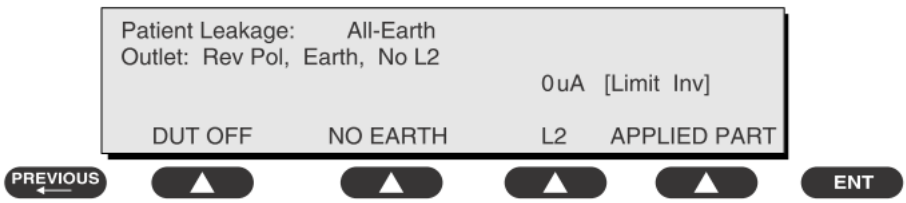
If all of the applied parts correspond to the instrument type, the applied parts will be tied together and one reading will be taken. If any of the applied parts differ from the instrument type, all applied parts will be tested individually, based on the type of applied part. This applies to Auto and Step modes only.

◆Perform the Test

1) From the MAIN MENU, or with the outlet unpowered, plug the DUT into the 601PRO front panel outlet, and turn on the device.

2) Attach the applied parts to the 601PRO's applied part terminals.

3) Press shortcut key 6. The Patient Leakage test is displayed, and the test begins immediately.



4) Press APPLIED PART (SOFT KEY 4) at any time to select the desired applied part leakage current.

5) Modify the configuration of the front panel outlet by pressing the appropriate SOFT KEY on the 601PRO.

6) Press the print data key at any time to generate a printout of the latest measurement.

ELECTRICAL SAFETY INSPECTION

6- Patient Leakage Current

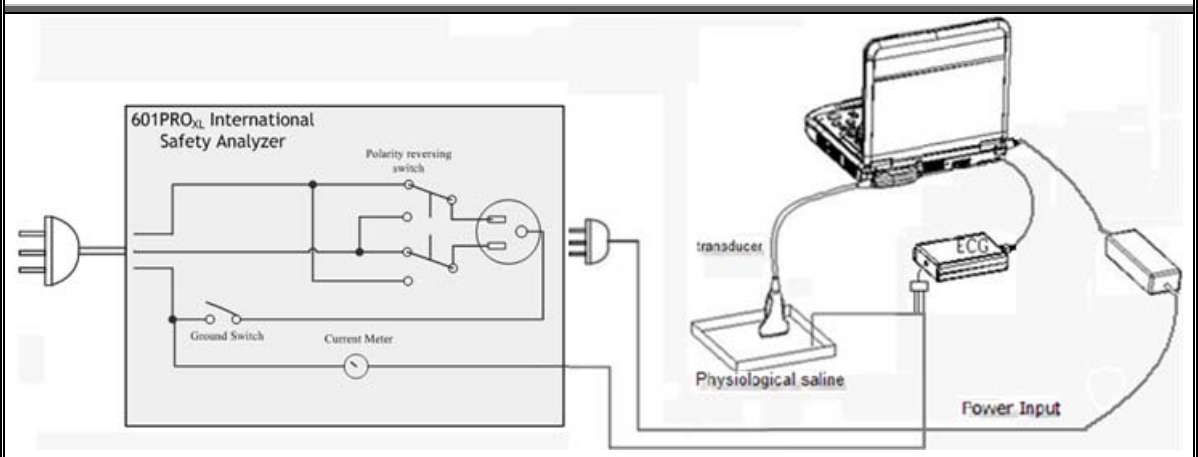


Figure 2 patient leakage Current

◆Note

1, In addition to Probes ,Patient leakage current test should be perform if ECG or PCG parts used;

2, If the current test standard being used does not include Patient Leakage DC readings, or the DC option is not enabled, then DC readings will not be available through the APPLIED PART SOFT KEY selections. Refer to Chapter 8, Standards and Principles.

◆Failure

Check any broken of the Applied parts. Replace any defective one.

Check any broken of the ECG/PCG module if used, Replace any defective one.

Check any broken of the Power Unit. Replace a new one if any portion defective.

Inspect wiring for bad crimps, poor connections, or damage.

Test the wall outlet; verify it is grounded and is free of other wiring abnormalities. Notify the user or owner to correct any deviations. As a work around, check the other outlets to see if they could be used instead.

Change another probe to confirm if the fail is caused by console.

Inspect wiring for bad crimps, poor connections, or damage.

If the leakage current measurement tests fail on a new unit and if situation can not be corrected, submit a Safety Failure Report to document the system problem. Remove unit from operation.

If all else fails, stop using and inform the Customer Service Engineer for analysis and disposal.

LIMITS

ELECTRICAL SAFETY INSPECTION

6- Patient Leakage Current

All countries

For BF ECG input and transducer

100 μ A Normal Condition

500 μ A Single Fault Condition

ELECTRICAL SAFETY INSPECTION

7- Mains on Applied Part Leakage

OVERVIEW

The Mains on Applied Part test applies a test voltage, which is 110% of the mains voltage, through a limiting resistance, to selected applied part terminals. Current measurements are then taken between the selected applied part and earth. Measurements are taken with the test voltage (110% of mains) to applied parts in the normal and reverse polarity conditions as indicated on the display.

The following outlet conditions apply when performing the Mains on Applied Part test.

Normal Polarity;

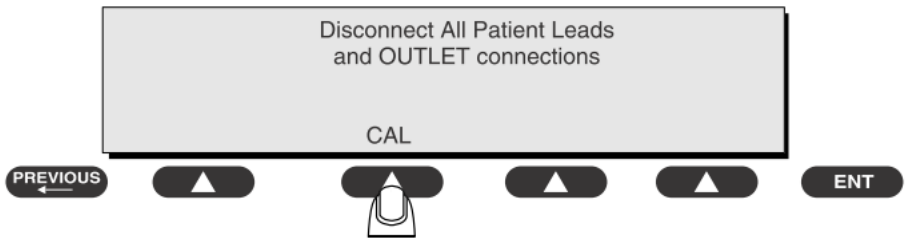
Reversed Polarity

TEST PROCEDURE

◆Prepare

To perform a calibration from the Mains on Applied Part test, press CAL (SOFT KEY 2).

1) Disconnect ALL patient leads, test leads, and DUT outlet connections.
2) Press CAL to begin calibration, as shown:



If the calibration fails, the previously stored readings will be used until a passing calibration has occurred. Also, the esc/stop key has no effect during calibration.

3) When the calibration is finished, the Mains on Applied Part test will reappear.

◆ Warning

1) A 2-beep-per-second signal indicates high voltage present at the applied part terminals while a calibration is being performed.
2) High voltage is present at applied part terminals while measurements are being taken.

◆Performance

1) From the MAIN MENU, or with the outlet unpowered, plug the DUT into the 601

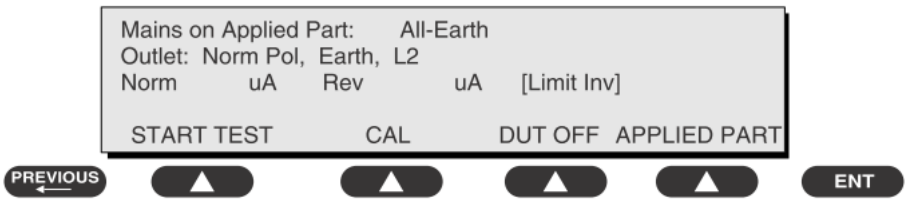
ELECTRICAL SAFETY INSPECTION

7- Mains on Applied Part Leakage

2) Attach the applied parts to the 601PRO applied part terminals.

3) Attach the red terminal lead to a conductive part on the DUT enclosure.

4) Press shortcut key 7. The Mains on Applied Part test is displayed.



5) Select the desired outlet configuration and applied part to test using the appropriate SOFT KEYS:

6) Press START TEST (SOFT KEY 1) to begin the test.

7) Press the print data key to generate a printout of the latest measurement.

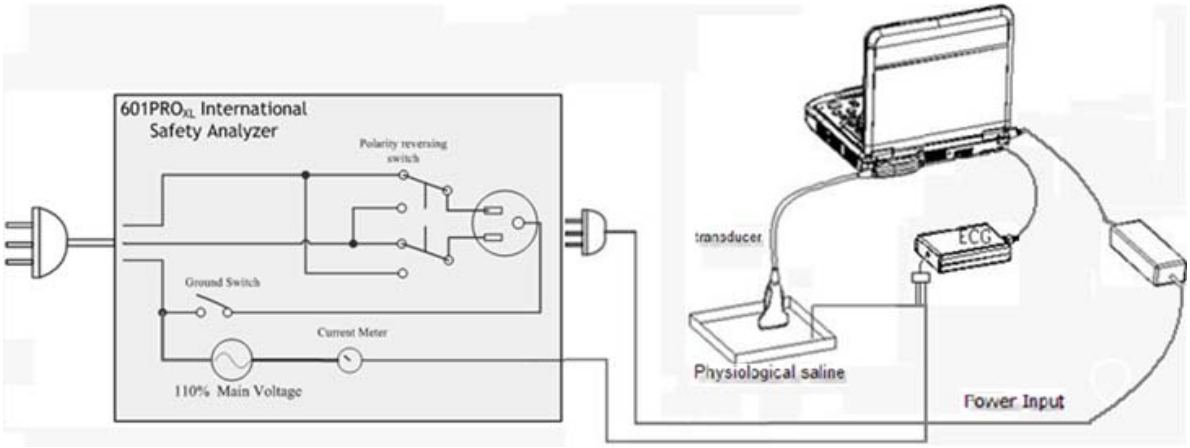


Figure 3 Mains on Applied part leakage

◆Note

1, In addition to Probes ,Patient leakage current test should be perform if ECG or PCG parts used;

2, If all of the applied parts correspond to the instrument type, the applied parts will be tied together and one reading will be taken. If any of the applied parts differ from the instrument type, all applied parts will be tested individually, based on the type of applied part. This applies to Auto and Step modes only.

◆Failure

Check any broken of the Applied part. Replace any defective one.

Check any broken of the ECG/PCG module if used, Replace any defective one.

Check any broken of the Power Unit. Replace a new one if any portion defective.

Inspect wiring for bad crimps, poor connections, or damage.

ELECTRICAL SAFETY INSPECTION

7- Mains on Applied Part Leakage

Test the wall outlet; verify it is grounded and is free of other wiring abnormalities. Notify the user or owner to correct any deviations. As a work around, check the other outlets to see if they could be used instead.

Change another probe to confirm if the fail is caused by console.

Inspect wiring for bad crimps, poor connections, or damage.

If the leakage current measurement tests fail on a new unit and if situation can not be corrected, submit a Safety Failure Report to document the system problem. Remove unit from operation.

If all else fails, stop using and inform the Customer Service Engineer for analysis and disposal.

LIMITS

All countries:

For BF ECG input and transducer:

5000 μ A

ELECTRICAL SAFETY INSPECTION

8- Patient Auxiliary Current

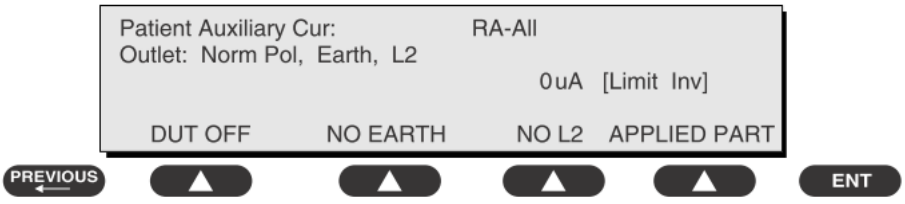
overview

Patient Auxiliary currents are measured between any selected ECG jack and the remaining selected ECG jacks. All measurements may have either a true RMS or a DC-only response.

TEST PROCEDURE

◆Prepare

1) From the MAIN MENU, or with the outlet unpowered, plug the DUT into the 601PRO front panel outlet, and turn on the device.
2) Attach the patient leads to the 601PRO ECG jacks.
3) Define the Lead Types from the View Settings Option (refer to: Lead Type Definitions in Section 5 of this chapter).
4) Press shortcut key 8. The Patient Auxiliary Current test is displayed, and the test begins immediately. Display values are continuously updated until another test is selected.



5) Press SOFT KEYS 1-4 to select leakage tests
6) Press APPLIED PART (SOFT KEY 4) at any time to select the desired applied part leakage current:
7) Modify the configuration of the front panel outlet by pressing the appropriate SOFT KEY on the 601PRO:
8) Press the print data key at any time to generate a printout of the latest measurement.

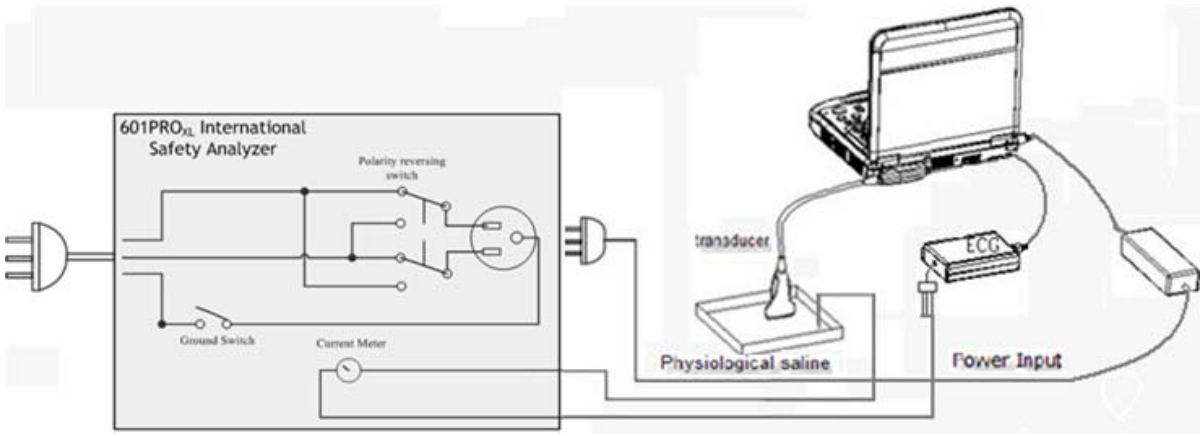


Figure 4 patient Auxiliary Current

ELECTRICAL SAFETY INSPECTION

8- Patient Auxiliary Current

◆Note

If the current test standard being used does not include Patient Auxiliary Current DC readings, or the DC option is not enabled, then DC readings will not be available through the APPLIED PART SOFT KEY selections.

◆Failure

Check any broken of the AC cable. Replace a new one if any portion defective.

Check any broken of the enclosure. Replace any defective part.

Inspect wiring for bad crimps, poor connections, or damage.

Test the wall outlet; verify it is grounded and is free of other wiring abnormalities. Notify the user or owner to correct any deviations. As a work around, check the other outlets to see if they could be used instead.

Change another probe to confirm if the fail is caused by console.

Inspect wiring for bad crimps, poor connections, or damage.

If the leakage current measurement tests fail on a new unit and if situation can not be corrected, submit a Safety Failure Report to document the system problem. Remove unit from operation.

If all else fails, stop using and inform the Customer Service Engineer for analysis and disposal.

LIMITS

All countries

For BF ECG input and transducer

100 μA Normal Condition

500 μA Single Fault Condition

ELECTRICAL SAFETY INSPECTION FORM

（Class I equipment）

Overall assessment:

☐ Scheduled inspection Test item: 1, 2, 3, 9

☐ Unopened repair type Test item: 1, 2, 3, 9

☐ Opened repair type, not modify the power part including transformer or patient circuit board Test item: 1, 2, 3, 4, 5, 9

☐ Opened repair type, modify the power part including transformer or patient circuit board Test item: 1, 2, 3, 4, 5, 6, 7, 8, 9

Location:				**Technician:**	
Equipment:				**Control Number:**	
Manufacturer:		**Model:**		**SN:**	
Measurement equipment /SN:				**Date of Calibration:**	
INSPECTION AND TESTING				**Pass/Fail**	**Limit**
1	Power Cord Plug				
2	Device Enclosure and Accessories				
3	Device Labeling				
4	Protective Earth Resistance		Ω		Max 0.2 Ω
5	Earth Leakage	Normal condition(NC)	____μA		Max: NC: 300μA(refer to UL60601-1) * NC: 500μA(refer to IEC60601-1) * SFC: 1000μA
		Single Fault condition(SFC)	____μA		
6	Patient Leakage Current	Normal condition(NC)	☐BF____μA		Max: BF applied part: NC:100μA, SFC: 500μA
		Single Fault condition(SFC)	☐BF____μA		
7	Mains on Applied Part Leakage		☐BF____μA		Max: BF applied part: 5000μA
8	Patient Auxliary Leakage Current	Normal condition(NC)	☐BF____μA		Max: BF applied part: NC:100μA, SFC: 500μA
		Single Fault condition(SFC)	☐BF____μA		

Note:

The equipment which sell to America shall comply with the requirement of UL60601-1, others shall comply with the requirement of IEC60601-1.

Name/ Signature: _____ Date:_____

Appendix B Phantom Usage Illustration

Targets Disposal of Phantom KS107BD

A1——A5： Axial resolution target group B:Blind-area target group

C： Longitudinal target group D： Horizontal target group

E:Mimic tumor F： Mimic sac (diam 10mm) and stone

G Mimic sac (diam 6mm)

4. Line Target System

There are 8 groups of nylon line targets disposed as shown in the figure.

1．A1——A5：

Axial and lateral resolution target group. The distances between the horizontal branch and the acoustic window are 30, 50, 70, 120 and 160mm, the center horizontal distances between two adjacent lines of A1 and A2 groups are 1, 5, 4, 3, 2mm, A3~A5 groups are 5, 4, 3, 2mm. The center longitudinal distances between two adjacent lines of the longitudinal branches are 4, 3, 2, 1mm.

2．B：

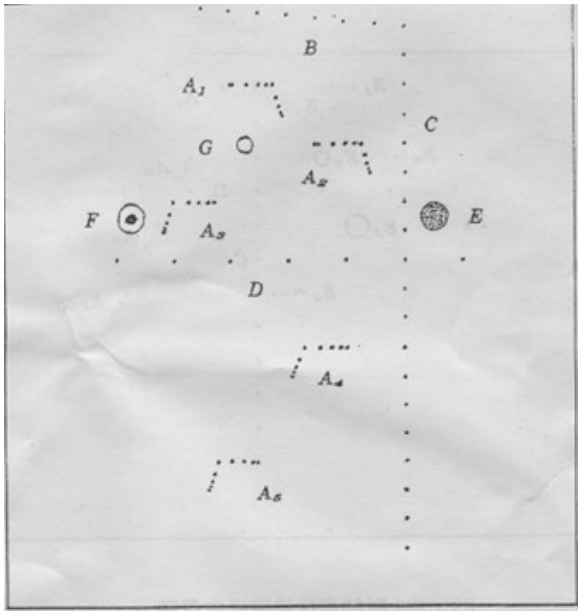
Blind-area target group. Center horizontal distance of adjacent lines is 10mm, distances to the acoustic window are 10, 9, 8, 7, 6, 5, 4, 3mm.

3．C：

Longitudinal target group. 19 target lines with a 10mm center distance between adjacent lines.

4．D：

Horizontal target group. 7 target lines with a 20mm center distance between adjacent lines.



Targets disposal- KS107BD

A1——A4 Axial resolution target group

B1——B4 Lateral resolution target group

C Longitudinal target group

D Horizontal target group

E1——E3 Mimic sacs with diameters of 2, 4, 6mm

4. Line Target System

There are 8 groups of line targets disposed in TM material as shown in the figure.

1．A1——A4：

Axial resolution target group. The upmost lines in each target locate at the depth of 10, 30, 50, 70mm, the center longitudinal distances of each group (from the top down) are 3, 2, 1, 0.5mm, and the horizontal distance is 1mm.

2．B1——B4：

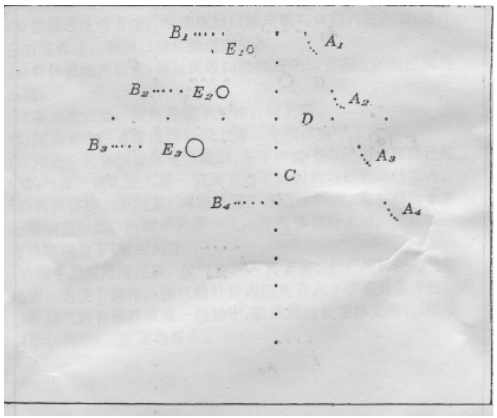
Lateral resolution target group. Locate at a depth of 10, 30, 50, 70mm, with a center horizontal distance of 4, 3, 2, 1mm in each group.

3．C：

Longitudinal target group. 12 target lines with a 10mm center distance between adjacent lines.

4．D：

Horizontal target group. Locate at a depth of 40mm, with a 20mm center distance between adjacent lines.



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